Volume 22, Number 16, August 31, 1968

NUCLEAR SCIENCE ABSTRACTS

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Index References

All index entries refer the reader to volume and abstract number:

FOURRIER, Alain
  Radioactive chain of mass number 189, 21:10023

Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

MONTH, M.
  Theory of gradient perturbations in AGS, 21:9872 (BNL-10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic form factors of the deuteron, 21:9744

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

SHEEP
  radiation dosimetry in, measurement of lethal dose of x, 21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x, 21:8905(R) (AD-631189)

SHELTERS
  construction of, for civil defense, 21:8838
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  design of shaft closure for, 21:8563(P)
  determination of configuration of, for ventilation, 21:8779(R) (AD-629928)
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  evaluation of fallout, for fire and air blast damage, 21:8560 (URS-658-3)
  fire resistance of components of, evaluation of, 21:8789(R) (AD-642241)

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Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

UNION CARBIDE CORP., OAK RIDGE, TENN. Y-12 PLANT.
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3311(Suppl. 2)	21-8567	Dep. mn. CFSTI $3.00 cy, $0.65 mn
22298	21-9915	Nucl. News, 9: No. 12, 17-21 (Dec. 1966)
22298	21-9914	Nucl. News, 10: No. 1, 17-20(Jan. 1967)
23267	21-9702	Phys. Rev., 152: 1171-82(Dec. 23, 1966)
23287	21-8498	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23420	21-8764	Lancet, 2: 672-5(Sept. 24, 1966)
23474	21-8528	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23478	21-8641	Dep. mn. CFSTI $3.00 cy, $0.65 mn
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Volume 22, Number 16 August 31, 1968

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 33319, 33359, 33379, 33400, 33818, 35280, and 35313.

33203 (AAEC/TM-437) STUDIES IN COMPUTER COUPLED RADIOCHEMICAL ANALYSIS. PART 1. PEAK LOCATION AND PEAK ENERGY MEASUREMENT IN SCINTILLATION SPECTROMETRY. Palmer, A. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1968. 26p. Dep.

A FORTRAN IV (Level H) program is described, which locates photopeaks in the output of a multichannel analyzer scintillation spectrometer assembly. The program is particularly useful for processing the output of large-capacity analyzers working in conjunction with a high-resolution Ge(Li) detector. (auth)

33204 (AERE-AM-106) DETERMINATION OF TRACES OF COPPER, ARSENIC AND ANTIMONY IN STEELS AND STEEL OXIDES BY NEUTRON-ACTIVATION ANALYSIS. Perkins, M.; Rees, T. B. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 16p. Dep. CFSTI. UK 3s. 0d.

The method involves irradiation of the sample, with control standards of arsenic, antimony, and copper, in a flux of approximately 10^{12} neutrons cm^{-2} sec^{-1} for about 12 hours. After dissolution of the sample in the presence of carriers, trivalent arsenic is separated by distillation as the chloride at 110°C in the presence of a reducing agent. Antimony is then distilled as the trichloride at 160°C, the copper remaining in the residue. Simple radiochemical decontamination steps are then applied to each of these fractions and finally the radioactivity of the ^{76}As, ^{122}Sb, and ^{64}Cu from sample is compared with that from the control standards. The method is applicable to mild and stainless steels and their "insoluble" oxides. The sensitivity is such that 10^{-9} g of arsenic, antimony, and copper can be measured with a coefficient of variation not exceeding 5%. (auth) (UK)

33205 (AWRE-O-3/68) VALUE OF TRACE ANALYSIS IN THE COMPARISON OF GLASS FRAGMENTS. A Preliminary Study. Coleman, R. F.; Wood, G. A. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr. 1968. 17p. Dep. CFSTI. UK 3s. 3d.

Emission spectroscopy, mass spectrometry, and activation analysis are discussed as methods of glass analysis. Results obtained by neutron activation of glass samples representing many years of production at one Belgian and two UK works are reported, and considered in relation to the forensic problem of fragment comparison. Suggestions for future work are made. (auth) (UK)

33206 (DP-MS-67-62) ROUTINE ISOTOPIC ANALYSIS OF LITHIUM IN Li-Al ALLOY BY ATOMIC ABSORPTION SPECTROMETRY. Wheat, J. Allen (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sept. 13, 1967. Contract AT(07-2)-1. 10p. (CONF-671012-7). Dep. CFSTI.

From 11th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

An atomic-absorption spectrometric method was developed that is sufficiently precise and accurate for routine isotopic analysis of lithium in Li-Al alloys. The method simultaneously determines the isotopic composition and the molar concentration of lithium. Aluminum in concentrations up to 200 times that of the lithium in acid solutions of the alloy did not interfere with the atomic absorbance measurements. The basis for the atomic-absorption method is the isotope shift in the absorption spectra for ^{6}Li and ^{7}Li. Two absorption lines of ^{6}Li and two of ^{7}Li occur in a 0.30 Å region of the spectrum at 6708 Å; the stronger ^{6}Li line is superimposed on the weaker ^{7}Li line. The two absorption lines of each isotope are separated by 0.15 Å, and the shift between isotopes is also 0.15 Å. The ratio of the atomic absorbances of a lithium solution measured with two emission sources containing different atom ratios of ^{6}Li and ^{7}Li was related to the isotopic composition of the lithium in the solution. Since the absorption by neither lithium isotope strictly obeyed Beer's Law, the measured absorbance ratios of lithium solutions varied not only with isotopic composition but also to some extent with concentration. The minimum departure from Beer's Law was between 4.3×10^{-4} and $5.7 \times 10^{-4}\underline{M}$ total lithium. In this range, and for isotopic compositions of ^{6}Li between 7 and 68%, the relative precision of the isotopic analysis was 1.8%. (auth)

33207 (LA-DC-8999) MASS SPECTROMETER FOR HIGH-TEMPERATURE INERT GAS ANALYSIS. Wilson, N. G.; Winkelman, C. R. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 17p. (CONF-680401-2). Dep. CFSTI.

From 4th General Meeting on International Organization for Vacuum Science and Technology, Manchester, England.

A mass spectrometer designed for analysis of inert gases at temperatures up to 300°C was developed for on-line analysis of cover gases in liquid-metal-cooled nuclear reactors. Use of a 100-liter/sec sputter-ion pump in series with a thermoelectrically cooled baffle and a 280-liter/sec oil diffusion pump is a new approach to ultra-clean vacuum system construction. No cryogenic fluids or absorbents are required to minimize background buildup from the sampled gases or from the oil diffusion pump. A differentially pumped gas inlet system allows sample rates varying from less than 1×10^{-5} torr-liter/sec to greater than 1 torr-liter/sec. The differentially pumped flow splitting chamber is isolated from back diffusion of mechanical pump oil vapor by an ionization baffle. Operation of the system for approximately six months in tests showed negligible buildup of hydrocarbon backgrounds. The sensitivity observed for the instrument indicates that contaminant concentrations of less than 1 part in 10^{8} can be observed. The quadrupole mass filter used in the mass spectrometer provides integral mass resolution for mass numbers from 1 to 500. Scan rates of 10 sec to 400 μsec per mass number allow conventional strip chart or digital recording techniques, or direct view on an oscilloscope. (auth)

33208 (MLM-1456) MOUND LABORATORY PROGRESS REPORT FOR CHEMISTRY, OCTOBER-DECEMBER 1967. (Mound Lab., Miamisburg, Ohio). Dec. 29, 1967. Contract AT(33-1)-Gen-53. 82p. Dep. CFSTI.

Research progress is reported under the following topics: alpha-beta branching ratio of ^{227}Ac, half-life of ^{209}Po, ^{233}U decay chain, ^{209}Po in reactor-produced ^{210}Po, decay scheme of ^{210m}Bi, characterization of heavy metal-inorganic ion exchange systems, dissolution of PuO_2, ^{234}U recovery, ^{228}Th recovery, ^{227}Ac production, techniques for measuring internal conversion coefficients, gamma assay of ^{238}Pu in waste, ^{206}Pb recovery, internal friction of neptunium, separation of small quantities of boron in KCl-KF mixture, thermal stability of nitrated Dowex 1X4 resins, and ion plating studies. (M.C.G.)

33209 (NSJ-tr-103) A TRIAL METHOD OF DETERMINING URANIUM AND THORIUM CONTENT IN ROCKS BY THE RADIOACTIVE MEASUREMENTS. [PART] 2. Nishimura, Susumu; Hatuda, Zin'ichiro; Asayama, Tetsuji. Translated from Radioisotopes (Tokyo), 15: 289-94(1966). 20p.

An abstract of this report, prepared from the original language, appeared as NSA 21: 4452. (R.C.K.)

33210 (SC-R-68-1723) BIBLIOGRAPHY ON THE DETERMINATION OF NITROGEN BY ACTIVATION ANALYSIS. Stalnaker, Nelson D.; Kahn, Milton; Kenna, B. T. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1968. 20p. Dep. CFSTI.

This bibliography on the determination of nitrogen by activation analysis contains 130 references to articles, bibliographies, books, reviews, and reports. The references were obtained from Nuclear Science Abstracts, Chemical Abstracts, and Chemical Titles for the period January 1951 through June 1967, inclusive. (auth)

33211 SOME APPLICATIONS OF LOW-ENERGY GAMMA AND X-RAY SOURCE IN POLAND. Ostrowski, Kazimierz W.; Gorski, Ludwik; Niewodniczanski, Jerzy. (Inst. of Nuclear Techniques, Krakow). Nukleonika, 13: 289-300(1968).

In work on nondispersive x-ray-fluorescence analysis, ^{170}Tm, T/Zr, ^{147}Pm/Al, ^{90}Sr/Pb, ^{55}Fe, ^{109}Cd, and ^{241}Am sources were used. X-ray-fluorescence methods of analysis were developed for determination of Cu, Zn, Fe, and Zr in ores. A method for determination of calcium in cement mixes was developed, and one for rapid and precise tungsten determination in tool steel was worked out. Two methods are routinely used in industry: determination of tungsten in tool steel and iron in iron ores. Absorption methods were also developed, and some research was done on the elimination of matrix effects and on nomographic interpretation of measurements of three-component materials. Results were obtained in the application of scattered low-energy gamma or x rays to the determination of iron in iron-bearing sands and of sulfur in hydrocarbons. The construction of special x-ray proportional counters with large windows permitted obtaining these results. (auth)

33212 RADIOMETRIC ANALYSES WITH HIGH-YIELD PROPORTIONAL X-RAY COUNTERS AND LOW-ACTIVITY SOURCES. Ostrowski, Kazimierz; Jelen, Kazimierz; Rulikowska, Elzbieta (Inst. of Nuclear Techniques, Krakow). Nukleonika, 13: 301-12(1968).

Work was carried out on the application of x radiation in radiometric analysis. Some criterions for the proper choice of radioisotope sources are presented, and properties of the detectors constructed are described. Some examples of analyses (iron and copper ores, sulfur in hydrocarbons) using the specially chosen sources and detectors are described. Improved geometrical arrangements are also discussed. (auth)

33213 PROBLEMS AND POSSIBILITIES OF MODERN TRACE ANALYSIS. Specker, H. (Univ., Bochum, Ger.). Angew. Chem. Int. Ed. Engl., 7: 252-9(Apr. 1968).

As a result of the development of measuring techniques, analytical chemists can now determine very small quantities as well as trace concentrations of the order of 10^{-8}% with good accuracy. In exceptional cases it is even possible to detect 10^5 atoms of an element. Definitions of important analytical terms are outlined and a critical appraisal of the principal methods of trace analysis is given. (auth)

33214 IDENTIFICATION OF AN UNKNOWN CONSTITUENT IN THE ELECTRON-PROBE MICROANALYSIS OF INCLUSIONS IN IRRADIATED OXIDE FUELS. Yates, G.; Bramman, J. I. (United Kingdom Atomic Energy Authority, Thurso, Scotland). J. Nucl. Mater., 27: 88-93(1968).

A method is described which enables the constituent elements of a specimen to be positively identified from the data likely to be obtained during the qualitative electron-probe microanalysis of irradiated material. The method depends on being able to determine n, the order of diffraction of the various peaks recorded during a scan of the excited x-ray spectrum of a specimen of totally unknown composition, and makes possible the unambiguous identification of an element from only one peak of its characteristic spectrum. Using the technique described it was shown that chlorine as a minor constituent is the element responsible for hitherto unidentified peaks noted during the examination of fission product aggregates in irradiated oxide fuels. (auth)

33215 ANALYSIS OF PLUTONIUM URANIUM CARBIDE–IRON CERMETS BY ELECTROCHEMICAL METHODS. Milner, G. W. C.; Wood, A. J.; Phillips, G.; Weldrick, G. J. (Atomic Energy Establishment, Harwell, Eng.). Z. Anal. Chem., 224: 346-56(1967).

The sample was digested in HNO_3 and, if any residue was left, a few drops of HF were added to complete the dissolution; H_2SO_4 (3 ml) was added, and the solution evaporated to fumes, cooled and diluted to 50 ml. An aliquot (containing ≃4 mg of Pu) was oxidized with AgO, then reduced with Fe^{2+}, and the excess of Fe^{2+} was titrated with Ce^{4+}. Iron was determined on a separate aliquot (containing ≃1 mg of Fe) by coulometric oxidation, and an allowance was made for a contribution by Pu. An aliquot (containing 10 mg of U), after addition of $HClO_4$ and evaporated to fumes of H_2SO_4, was oxidized electrolytically and U was then determined by coulometric reduction. Coefficients of variation are: Pu (mg) 0.1%, Fe (1 mg) 0.25%, and U (10 mg) 0.25%. Carbon was determined manometrically after combustion. (Anal. Abstr.)

33216 RAPID DETERMINATION OF RARE EARTH METALS IN PHOSPHATE ROCK. Kinnunen, J.; Wennerstrand, B. (Pori Works, Finland). Chem.-Anal., 56: No. 1-2, 24-5(1967).

The sample is fused with Na_2O_2, and the cooled melt is extracted with H_2O. Rare earth metals and alkaline earth metals are not dissolved, and most of the latter group are removed by extraction of the residue with aqueous NH_3-NH_4Cl solution. The residue is dissolved in HCl, a second hydroxide precipitation is carried out, and the precipitate is dissolved by heating with aqueous oxalic acid. The solution is cooled, then the precipitate of rare-earth-metal oxalates is filtered off, and ignited. The resulting oxides are dissolved in HCl for titration at pH 5.5 to 6 in the presence of F^- with EDTA solution (xylenol orange as indicator). (Anal. Abstr.)

33217 EXTRACTION–PHOTOMETRIC DETERMINATION OF LANTHANUM AS ITS COMPLEX WITH ALIZARIN RED S [C.I. MORDANT RED 3] AND 8-HYDROXYQUINOLINE. Serdyuk, L. S.; Lazorina, S. M. (Dnepropetrovsk State Univ., USSR). Zh. Anal. Khim., 21: 561-3(1966). (In Russian).

To 20 ml of 0.05$\underline{M}$ $Na_2B_4O_7$ in a separating-funnel add 0.1 ml of 0.1$\underline{M}$ Na salicylate (for masking Y), 1.5 ml of mM-Alizarin red S, the test solution and 3 ml of 0.3$\underline{M}$ ethanolic 8-hydroxyquinoline, and dilute to 25 ml with water. Then add 15 ml of butanol, and, after the separation of the phases, with centrifugation, measure the extinction of the organic phase at 530 nm against water. If Ce is present, add 0.1 ml of 10% H_2O_2 solution after the 8-hydroxyquinoline solution to destroy the Ce ternary complex by oxidation of Ce(III) to Ce(IV). When ≃30 to 50 μg of La was determined in the presence of up to twofold amounts of Y or La, the mean relative error was 3%. (Anal. Abstr.)

33218 DETERMINATION OF CADMIUM IN THORIUM NITRATE BY LINEAR-SWEEP CHRONOAMPEROMETRY WITH ANODIC STRIPPING. Khasgiwale, K. A.; Molina, R. (Atomic Energy Establishment, Trombay, India). J. Electroanal. Chem., 13: 144-8(1967). (In French).

Cadmium (0.01 to 0.1 μg per ml) was determined in the presence of Th(IV) (0.002$\underline{M}$ to 0.01$\underline{M}$) in a supporting electrolyte of 0.2$\underline{M}$ K_2CO_3 or M-KCl–0.01$\underline{M}$ HCl after pre-electrolysis for 0.5 to 5 min at a hanging mercury drop. Concentrations of ≃8 ppM of Cd with respect to Th can be determined to within ±14%. (Anal. Abstr.)

33219 CHEMILUMINESCENCE REACTION IN THE SYSTEM LUMINOL–COPPER(II)–ZIRCONIUM(IV)–HYDROGEN PEROXIDE [DETERMINATION OF ZIRCONIUM]. Babko, A. K.; Dubovenko, L. I.; Mikhailova, L. S. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Anal. Khim., 21: 548-52(1966). (In Russian).

The quenching effect of Zr(IV) on the luminescence of the system luminol–Cu(II)–H_2O_2 was studied; quenching was maximal pH 9 to 11.5. Based on this effect, a method was devised for the determination of down to 0.1 μg of Zr per 10 ml; it consists in photographic recording of the quenching effect and subsequent photometric evaluation of the photographic record. The coefficient of variation is ±25%. The quenching effect can also be evaluated by direct photo-electric measurement. (Anal. Abstr.)

33220 FLUORIMETRIC DETERMINATION OF EUROPIUM AND TERBIUM IN CONCENTRATES OF MINERAL RAW MATERIALS AND YTTRIUM OXIDE. Khomenko, V. S.; Kuznetsova, V. V.; Pekarskaya, L. A. Zh. Prikl. Spektrosk., 6: 117-18(1967). (In Russian).

Simple and reliable methods are described for determining Eu and Tb in monazite and yttrium oxide based on the fluorescence of the complexes formed between the metals and dibenzoylmethane (I) and 1,10-phenanthroline (II). The monazite was evaporated with concentrated HNO_3, then the residue was shaken with ethanol and I was added. The pH was adjusted to 7.3 to 7.5 with ethanolic NaOH and the solution was cooled in liquid N_2 or O_2 and the emission of Eu was measured at 615 nm and of Tb at 545 nm (excitation at 365 nm). The sensitivity was 0.01% of Eu or Tb and the analysis took 10 to 20 min. In another method for monazite a spectroscope was used (sensitivity 0.001% for Eu and 0.002% for Tb) and the analysis took 5 to 10 min. Yttrium chloride (obtained from the oxide) was dissolved in ethanol and precipitated with II. The sensitivity was 10^{-5}% for Eu and 10^{-4}% for Tb. The method of small additions was used for the analysis. (Anal. Abstr.)

33221 A FEASIBILITY STUDY OF NONDESTRUCTIVE ASSAY OF ^{239}Pu AND ^{235}U IN IRRADIATED SAMPLES USING SLOWING-DOWN-TIME LEAD SPECTROMETER. Navalkar, M. P.; Chandramoleshwar, K.; Ramakrishna, D. V. S. (Bhabha Atomic Research Centre, Trombay, India). Nukleonik, 11: 54-6(1968).

A method for nondestructive estimation of ^{239}Pu and ^{235}U in irradiated samples using a slowing-down-time lead spectrometer was proposed. Its feasibility was shown in case of unirradiated plutonium sample in the thickness range from 50 to 150 mg/cm^2. Based on experimental results obtained in the feasibility study, the counting rates, the accuracies in estimation etc., were worked out for a typical case of 1 kgm of natural uranium sample irradiated in the range from 250 to 1875 MWD/ton. Some of the advantages of the present method are summarized. (auth)

33222 A SPECTROPHOTOMETRIC STUDY OF THE UO_2^{2+} DIHYDROXYMALEIC ACID SYSTEM IN ORGANIC SOLVENTS. A NEW METHOD FOR THE DETERMINATION OF URANIUM(IV) IN THE PRESENCE OF THORIUM AND RARE EARTHS. Popea, Florica; Mavrodin, Maria (Centre of Inorganic Chemistry, Bucharest). Rev. Roum. Chim., 13: 591-9(May 1968).

A spectrophotometric study was made on the behaviour of the uranyl ion in the presence of dihydroxymaleic acid in methanol, ethanol, and acetone. The continuous variation method, the molar ratio method, and the slope ratio method emphasize in the three above mentioned solvents the compound UO_2^{2+}-dihydroxymaleic acid = 2/1. The compound in solid state was isolated from concentrated methanolic solutions. The reaction allowed the development of a new spectrophotometric method for the determination of uranium(VI) in the presence of thorium or of rare earths. The method is applicable for some uranium ores. (auth)

33223 ACTIVATION ANALYSIS OF GALLIUM USING SOLVENT EXTRACTION. El-Sherif, A.; Alian, A.; Allam, B.; David, N. (Atomic Energy Establishment, Cairo). Radiochim. Acta, 8: 181-4(Dec. 1967).

Three selective procedures were developed for the separation of radiogallium from other radionuclides, using extraction with isopropyl ether, hexone, and tributyl phosphate from hydrochloric acid. These procedures were applied to the neutron activation analysis of gallium using the standard addition technique. The 3 procedures are simpler and more rapid than those reported in the literature for activation analysis of gallium. (auth)

33224 NEUTRON ACTIVATION DETERMINATION OF INDIUM IN METEORITES. Tandon, S. N.; Wasson, John T. (Univ. of California, Los Angeles). Radiochim. Acta, 8: 184-8(Dec. 1967).

An improved method for neutron activation determination of indium in meteorites or other similar materials was developed. The 54-min ^{116m}In activity is separated from other interfering activities by diisopropyl ether extraction of the bromide complex and precipitation of $In(OH)_3$. The 1.29-MeV gamma is counted in a large well-type scintillation detector. The chemical yield is determined by atomic absorption spectrometry. Two samples can be processed in one half-life of the isotope. The detection limit for a thermal neutron flux of 2×10^{12} cm^{-2} sec^{-1} is 3×10^{-12} g. Results are presented for 10 chondrites, three iron meteorites, and olivine from a pallasite. (auth)

33225 ^{180m}Hf FOR ACTIVATION ANALYSIS OF HAFNIUM. Boudin, A.; Hanappe, F. (Univ. Libre, Brussels). Radiochim. Acta, 8: 188-91(Dec. 1967). (In French).

The application of ^{180m}Hf (γ,5.5 h) for determination of hafnium by activation, and more particularly of hafnium in presence of zirconium in natural samples was investigated. The couple ^{180m}Hf (^{97}Zr + ^{97}Nb) allows the simultaneous determination, without chemical separation, of the two elements. The cross section of the reaction ^{179}Hf(n,γ)^{180m}Hf was measured at $_{179}\sigma_{ac} = 0.34 \pm 0.15$ barn. A method of selective separation of hafnium and zirconium from rare earths minerals is described. (auth)

33226 QUANTITATIVE ANALYSIS OF NITROGEN USING GAMMA RAY SPECTROMETRY. Ishikawa, Hiroaki; Baba, Hiroyuki (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 17: 195-8(May 1968). (In Japanese).

A study on a quantitative analysis of nitrogen was made using gamma spectrometry. A given amount of aluminum oxide was employed as a calibration substance. 14-MeV neutron irradiation to the mixture of $(NH_4)_2SO_4$ and Al_2O_3 leads mainly to ^{14}N(n,2n)^{13}N, ^{27}Al(n,p)^{27}Mg, and ^{27}Al(n,α)^{24}Na reactions. The ratios of the partial full energy peaks of 0.51-MeV annihilation gamma rays due to ^{13}N to those of 0.84-MeV gamma rays from ^{27}Mg were found to be completely proportional to the amount of nitrogen added to a given amount of aluminum. Hence, nitrogen contained in certain materials can be analyzed quantitatively by the use of the relationship obtained above. Quantitative analysis of nitrogen in gluten was accomplished with around 4% error. (auth)

33227 DETERMINATION OF GOLD IN HIGH-PURITY CADMIUM BY NEUTRON ACTIVATION ANALYSIS. Mizuike, Atsushi; Fukuda, Katsuaki; Mitsuya, Nobuhiko (Nagoya Univ., Japan). Radioisotopes (Tokyo), 17: 199-202(May 1968).

Electrolysis with glassy carbon electrodes was employed as a preliminary separation step prior to thermal neutron irradiation. Low parts per billion of gold in cadmium metal was electrodeposited on a glassy-carbon cathode from hydrochloric acid–nitric acid solution in greater than 90% yields, leaving about 99.999% of cadmium in the electrolyte. The gold-deposited electrodes were then irradiated in a nuclear reactor. About 6 parts per billion of gold was found in a sample of commercial high-purity cadmium metal (purity 99.999%). (auth)

33228 RAPID VOLUMETRIC DETERMINATION OF NIOBIUM IN THE PRESENCE OF TITANIUM AND ZIRCONIUM BY HYDROGEN PEROXIDE COMPLEX FORMATION. Amemiya, Toshioki; Hirata, Hiroshi (Matsushita Electric Industrial Co., Ltd., Osaka). Bunseki Kagaku, 17: 565-9(May 1968). (In Japanese).

One gram of sample (mixture of oxides of titanium, niobium, and zirconium) is heated to dissolve in the mixture of 5 ml of 98% sulfuric acid and 3 g of ammonium sulfate, and diluted to 100 ml with distilled water. An aliquot of this solution is mixed with 5 ml of 0.1 M hydrogen peroxide, and titrated with 0.04 M potassium permanganate solution. The amount of niobium is calculated from the difference of the added and titrated volumes of hydrogen peroxide. To the above titrated solution is then added gradually the same volume of 98% sulfuric acid in an ice–water bath, and the titration is carried out at below 20°C. The amount of niobium is also calculated from this titer. One ml of 0.04 M $KMnO_4$ corresponds to 9.29 mg of niobium. A number of samples can be analyzed by the proposed method rapidly and conveniently without any special equipment or chemicals. (P.C.H.)

33229 DETERMINATION OF INORGANIC RADIO-IODIDES IN COMPOUNDS LABELLED WITH ^{131}I BY THIN LAYER CHROMATOGRAPHY. II. de Salas, G. N. B.; de Troparevsky, M. L. P.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires). Radiochim. Acta, 8: 224(Dec. 1967).

Radioactive inorganic iodides were determined in ^{131}I-labeled organic compounds by thin-layer chromatography and counting. (M.C.G.)

33230 EFFECT OF FIBER DIAMETER IN THE LIQUID SCINTILLATION COUNTING OF WOOL LABELED BY REACTION WITH [2-^{3}H] AND [2-^{14}C] IODOACETIC ACID. Downes, A. M.; Till, A. R. (Commonwealth Scientific and Industrial Research Organization, Prospect, New South Wales). Text. Res. J., 38: 518-22(May 1968).

Wool samples were labeled by reaction with aqueous solutions containing [2-^{14}C] iodoacetic acid or [2-^{3}H] iodoacetic acid. The counting rate of each sample was measured, first with the wool suspended in a liquid scintillation solution (direct method) and, second after oxidizing the same sample and dissolving the products in another liquid scintillation solution. The counting rate determined by the direct method depended on fiber diameter, because of self-absorption of β particles by the wool, whereas the counting efficiency of the oxidation method was constant. The ratio of the counting rates, direct/oxidized, for ^{14}C-labeled samples decreased linearly from 1.30 to 0.96 as the mean diameter increased from 14 to 35 μ. With ^{3}H-labeled wool, the inverse ratio, oxidized/direct, increased linearly from approximately 5.5 to 10.5 with increase in diameter from 14 to 35 μ. It was also shown that wool samples may be labeled with a known amount of ^{14}C by reaction with [2-^{14}C] iodoacetic acid dissolved in a liquid scintillation solution. The results, which show that the reaction occurred uniformly through the fiber, provide the basis for a new method of measuring mean fiber diameter. (auth)

33231 AN IMPROVED, SELECTIVE $\gamma-\gamma$ COINCIDENCE ARRANGEMENT FOR NONDESTRUCTIVE DETERMINATION OF SUBMICRO TRACES OF COPPER IN THE HIGH-PURITY METALS Be, Bi, Pb, Se, Sn, AND Tl. Woelfle, R.; Herpers, U.; Herr, W. (Univ., Cologne. Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem., 233: 241-52(1968). (In German).

Copper was determined nondestructively by neutron activation analysis in the high-purity metals Be, Bi, Pb, Se, Sn, and Tl and in an iron meteorite specimen down to concentrations of 40 ppB, while the detection-limit for 1 g-samples was about 0.006 ppB Cu. In γ,γ-coincidence counting of the annihilation radiation of ^{64}Cu an essentially improved suppression of interferences by other γ-cascade emitters was achieved by increasing the detector distances and by counting in centric and excentric positions with respect to the detectors. Using the 180°-angle correlation of the annihilation γ-quants of ^{64}Cu an increase in selectivity—in relation to conventional coincidence methods—was achieved by a factor of about 10^3. (auth)

33232 METHOD FOR DETERMINATION OF MICROAMOUNTS OF CHLORIDE IN FUEL SOLUTIONS OF HOMOGENEOUS SOLUTION REACTORS. Ehn, E.; Meier, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Radiochim. Acta, 8: 219-21(Dec. 1967). (In German).

For determination of microamounts of chloride in fuel solutions (solutions of uranyl salts) the chloride is oxidized to free chlorine. The chlorine is then separated from the bulk material by means of a microdiffusion method. Afterwards the amount of chlorine is measured spectrophotometrically using the pyridine-barbituric acid method developed by E. Asmus and H. Garschagen. This procedure permits the selective determination of chloride in the range of 0.5 to 10 μg. (auth)

33233 ANALYSIS OF IRON–TUNGSTEN AND MOLYBDENUM–TUNGSTEN ALLOYS. Popova, O. I.; Seraya, O. G. (Inst. of the Material Problems, Kiev). Zh. Anal. Khim., 23: 791-2(May 1968). (In Russian).

An indirect complexometric method for determining tungsten has been applied to the analysis of iron–tungsten and molybdenum–tungsten–carbon alloys. The method is based on the precipitation of tungsten (molybdenum) as lead tungstate (molybdate) followed by the determination of the lead salt excess by the direct complexometric titration in the same solution. Molybdenum and iron are determined complexometrically. (auth)

33234 DETERMINATION OF SMALL AMOUNTS OF SELENIUM AND TELLURIUM IN MINERAL MATERIAL USING CHROMATOGRAPHIC SEPARATION ON PAPER. Gelman, E. M. (North-West Geological Dept., Leningrad). Zh. Anal. Khim., 23: 736-40(May 1968). (In Russian).

A method has been developed for determining small amounts of selenium and tellurium in mineral material. Selenium and tellurium are separated by paper partition chromatography by means of n-butanol saturated with water with 4% of ammonium nitrate and 3 to 3.5% of nitric acid. Chromatograms are developed by a hydrochloric acid solution of $SnCl_2$. The element contents are found by photometry of the spots in reflected light or visually by comparing with a series of standard chromatograms. The method permits the determination from $n \times 10^{-4}$ to $n \times 10^{-2}$ of selenium and tellurium in ores. The sensitivity of the method is from 1×10^{-4} to 2×10^{-4}%. (auth)

33235 DETERMINATION OF MOLYBDENUM WITH DIACETYL, THIOUREA, AND STANNOUS CHLORIDE. Barkovskii, V. F.; Khurtova, L. N. (Ural State Univ., Sverdlovsk, USSR. Central Asiatic Scientific Research and Design Inst. of Non-Ferrous Metallurgy, Almalyk, USSR). Zh. Anal. Khim., 23: 691-5(May 1968). (In Russian).

In the reactions of ammonium molybdate, diacetyl, thiourea, and stannous chloride in an acid medium a complex compound is formed, of which the absorption spectra have maxima at 485 and 590 nm. The molar extinction coefficient at 590 nm is 3500. Rapid methods have been developed for the determination of molybdenum in ores and filter cakes. The relative error of determining 0.25 to 2.5% of molybdenum is not more than ±0.4%. (auth)

33236 SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF CHROMIUM IN PURE TANTALUM WITH DIPHENYLCARBAZIDE AFTER PRIOR ISOLATION AS ACETYLACETONATE. Hofer, Andreas; Heidinger, Rudolf (Oesterreichische Stickstoffwerke AG, Linz, Austria). Z. Anal. Chem., 233: 415-18(1968). (In German).

A method is reported for the determination of trace amounts of chromium in pure tantalum. Chromium is first chelated with acetylacetone by heating the sample solution under reflux and then separated by chloroform-extraction. After evaporating the chloroform and destroying the organic residue it is determined spectrophotometrically using diphenylcarbazide as reagent. 0.0005% of chromium can be determined in a sample of 1 g. (auth)

33237 EXTRACTION OF URANYL IONS AS A COMPOUND WITH NITRATE IONS AND RHODAMINE C. Burtnenko, L. M.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim., 23: 700-4(May 1968). (In Russian).

On the interaction of uranyl ions with rhodamine C in the presence of nitrate ions a three-component complex compound is formed which can be extracted by a mixture of benzene with acetone. Optimum conditions for the complex formation have been studied. It has been found by a spectrophotometric method that UO_2^{2+}, NO_3^-, and rhodamine C react at a ratio of 1:3:1. An extraction-photometric method has been developed for the determination of uranyl ions using rhodamine C. (auth)

33238 SOLVENT EXTRACTION SEPARATIONS WITH BPHA. APPLICATIONS TO THE MICROANALYSIS OF NIOBIUM AND ZIRCONIUM IN URANIUM. Vita, O. A.; Levier, W. A.; Litteral, E. (Goodyear Atomic Corp., Piketon, Ohio). Anal. Chim. Acta, 42: 87-94(July 1968).

A detailed study of the benzoylphenylhydroxylamine (BPHA)–chloroform–hydrochloric acid solvent extraction system with 52 elements is described with emphasis placed on extraction of the easily hydrolyzed transition metals from strong hydrochloric acid. A separation procedure for hafnium, niobium, tantalum, titanium, vanadium, and zirconium from uranium was developed, and procedures are given for the microdetermination of niobium and zirconium in uranium. Niobium and zirconium are separated from uranium by extraction into BPHA–chloroform from 10 $\underline{N}$ HCl. The separated elements are then measured colorimetrically as the niobium-4-(2-pyridylazo)resorcinol and zirconium–arsenazo III complexes. The limit of detection is 1 μg/g U. (auth)

33239 SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM AND OTHER COLOUR REACTIONS WITH 3,5,6,7,3',4'-HEXAHYDROXYFLAVONE. Katyal, Mohan (St. Stephen's Coll., Delhi); Gupta, B. P.; Bhardwaj, D. K.; Singh, R. P. Anal. Chim. Acta, 42: 173-6(July 1968).

The effects of various ions in hydrochloric acid medium on the spectrophotometric determination of Zr using 3,3′,4′,5,6,7-hexahydroxyflavone was investigated. There was no interference up to the amounts (in ppM) indicated within brackets of the following ions; Ba^{2+}(1000), Be^{2+}(15), Cd^{2+}(1200), Ca^{2+}(300), Co^{2+}(120), La^{3+}(230), Mg^{2+}(800), Mn^{2+}(90), Ni^{2+}(120), Pd^{2+}(20), Sr^{2+}(1000), UO_2^{2+}(10), Zn^{2+}(250), $CH_3CO_2^-$(1000), $B_4O_7^{2-}$(920), NO_3^-(920), CNS^-(35); however, traces of Cu^{2+}, Fe^{2+}, Ce^{4+}, Ti^{4+}, Th^{4+}, MoO_4^{2-}, I^-, IO_3^-, F^-, $S_2O_3^{2-}$, and PO_4^{3-} were found to interfere. Reactions of 3,3′,4′,-5,6,7-hexahydroxylflavone with uranyl, molybdate, and thorium ions are discussed, and plots of the absorption spectra of the uranyl, zirconium, and molybdenum complexes given. (D.H.M.)

33240 VACUUM-FUSION DETERMINATION OF OXYGEN IN ALUMINIUM AND ALUMINIUM–ALUMINIUM OXIDE COMPOSITES. Colombo, A.; Rodari, E. (CCR, Ispra, Italy). Anal. Chim. Acta, 42: 133-41(July 1968).

A copper bath–vacuum fusion method for the determination of oxygen in aluminum was modified because the extensive evaporation of copper at the operating temperature gave trouble in a commercial instrument with unlidded crucibles. The evaporation can be decreased by making use of graphite capsules, where the samples and the copper are sealed before being dropped into the hot crucible. The procedure gives good results for specimens of aluminum and of aluminum–aluminum oxide composites, the oxygen content of which ranged from some tens of ppM to some weight percent. The sensitivity of the method is of the order of 20 ppM for sample weights of 100 mg, if copper of very low oxygen content is used. (auth)

33241 ACTIVATION ANALYSIS OF RARE EARTHS. PART IV. DETERMINATION OF TRACES OF RARE-EARTH IMPURITIES IN Gd_2O_3. Massart, D. L.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 42: 166-70(July 1968).

In the determination of rare earth elements in Gd_2O_3 by neutron activation analysis, Eu can be determined without separation from Gd and Sm; however a separation from Co is necessary. The only other possible interference is from ^{160}Tb, and two procedures are given for separation of Tb and Eu. Two procedures are given for the separation of Eu and Sm since ^{153}Sa cannot be measured in the presence of ^{152m}Eu. Possible sources of errors are discussed. (D.H.M.)

33242 DETERMINATION OF URANIUM IN PLUTONIUM BY DIFFERENTIAL LINEAR SWEEP OSCILLOGRAPHIC POLAROGRAPHY. Plock, C. E.; Vasquez, J. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Anal. Chim. Acta, 42: 101-7 (July 1968).

The polarographic behavior of uranium in hydroxylamine hydrochloride was investigated by differential oscillographic polarography. A procedure is presented for the determination of uranium in plutonium for concentrations of uranium greater than 10 ppM. Analyses of solutions containing 22 common impurities found in plutonium metal revealed that antimony copper, and titanium cause significant interference. A reversible peak corresponding to a one-electron reduction was obtained with a peak potential of −0.167 V vs Hg pool electrode. The diffusion coefficient is 0.51×10^{-5} cm²/sec and the diffusion current constant is 1.59 with an average relative standard deviation of 2.28%. The peak current of uranium can be affected by hydrochloric, nitric, perchloric, and sulfuric acids, depending on the acid concentration. (auth)

33243 OSCILLOPOLAROGRAPHIC DETERMINATION OF URANIUM AND THORIUM IN SUPPORTING ELECTROLYTES CONTAINING CUPFERRON. Donoso N., G.; Santa Ana V., M. A.;

Chadwick W., I. (Univ., Chile, Santiago). Anal. Chim. Acta, 42: 109-18(July 1968).

Uranium(VI and IV) and thorium(IV) give cathodic indentations in supporting electrolytes prepared from $0.1\underline{M}$ perchloric acid, 0.5M ammonium thiocyanate, and $5 \times 10^{-3}\underline{M}$ cupferron (solution A) or from $0.1\underline{M}$ succinic–succinate buffer pH 4, $0.1\underline{M}$ sodium chloride, $10^{-3}\underline{M}$ cupferron, and 0.05% gelatine (solution B). The uranium indentation on the $dE/dt = f(E)$ curve ($Q = 0.75$ and 0.73) permits its detection at the $3 \times 10^{-7}\underline{M}$ level. The thorium indentation ($Q = 0.78$) permits its detection at the $4 \times 10^{-7}\underline{M}$ level in solution B. Methods for the elimination of interfering ions for the uranium determination are described. In the determination of thorium, Ga(III), Fe(III), Ti(IV), and U(VI) interfere. (auth)

33244 TRACE FLUORIDE DETERMINATION WITH SPECIFIC ION ELECTRODE. Baumann, Elizabeth W. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Anal. Chim. Acta, 42: 127-32 (July 1968).

A method is described for determining 10^{-5} to $10^{-4}\underline{M}$ fluoride in a variety of solutions potentiometrically with a fluoride-specific electrode, by a standard addition method. Any change of ionic strength or the nature of the solution that might alter activity coefficients or junction potentials is minimized. The relationship between potential and fluoride concentration thus follows the Nernst equation, and the unknown concentration can be calculated. Experimental data are given for solutions of sodium chloride, sodium nitrate, acidified sodium silicate and sodium hydroxide, lithium chloride, and phosphoric acid. Metal ions (e.g., Al^{3+}, UO_2^{2+}, Fe^{3+}, Th^{4+}) that interfere by forming complexes with fluoride can be precomplexed with phosphoric acid. The relative error is estimated at 10%, and the relative standard deviation is less than 5% over the concentration range 10^{-5} to $10^{-4}\underline{M}$ fluoride. (auth)

33245 ANALYSIS OF CHROMIUM BY γ-SPECTROMETRY AFTER SEPARATION OF THE RADIOELEMENTS BY ION EXCHANGE. Dugain, F.; Castre, C.; Beyssier, B. (Compagnie Pechiney L.R.M., Grenoble, France). Anal. Chim. Acta, 42: 39-50(July 1968). (In French).

A procedure is given for the determination of 9 elements in chromium matrix. After neutron irradiation, all separations, on Dowex I resin with chloride or fluoride–chloride eluants, can be done in a "cold" laboratory. Fe, Co, Ni, Cu, Zn, W, Mo, Ga, and Ta can be determined. The lower limit of determination is ca 1 ppM, except for Fe. The reproducibility is about 10%. (auth)

33246 ACTIVATION ANALYSIS OF RARE EARTHS. PART I. SEPARATION OF RARE EARTHS FROM ACCOMPANYING ELEMENTS. Massart, D. L.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 42: 7-14(July 1968).

A scheme for the separation of rare earth elements from gadolinite and tantalocolumbite minerals is discussed. The possibility of interference from traces of non-separated elements in the subsequent separation of rare earth elements from each other by cation exchange with α-hydroxyisobutyrate as the eluting agent was investigated. (auth)

33247 ACTIVATION ANALYSIS OF RARE EARTHS. PART II. DETERMINATION OF LUTETIUM IN GADOLINITE. Massart, D. L.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 42: 15-20(July 1968).

Two precise and accurate methods for the determination of lutetium in the presence of other rare earths and after separation from a mineral, gadolinite, are described. Both methods require separation of the lutetium and ytterbium from the other rare earths. A complete separation of Lu and Yb is necessary when integral counting is used. The other method differentiates between the two elements by γ-spectrometry. (auth)

33248 ACTIVATION ANALYSIS OF RARE EARTHS. PART III. THE DETERMINATION OF RARE EARTHS IN MINERALS BY THE SINGLE COMPARATOR TECHNIQUE. Massart, D. L.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 42: 21-8(July 1968).

The determination of rare earths in minerals by activation analysis is described. The rare earths were separated as a group from the bulk of the material before irradiation. After irradiation the rare earths were separated from each other by gradient elution with ammonium α-hydroxyisobutyrate on a cation-exchange column. The elements were determined by the single comparator technique. This method permits a practical application of activation analysis to the routine determination of rare earths in complex matrices. (auth)

33249 DETERMINATION OF INORGANIC IODINE IN BLOOD SERUM. Bednar, J.; Roehling, S. (Research Inst. of Endocrinology, Prague). Cesk. Farm., 16: No. 1, 19-21(1967). (In Czech).

The modified alkaline combustion method for the determination of inorganic iodine as the difference between total and protein iodine was affected by the concentration of inorganic iodine in the serum; if this is <1 μg per 100 ml, the error is >10%. An investigation of the direct determination of inorganic iodine showed results to be satisfactory for model experiments, but not for determinations in serum. (Anal. Abstr.)

33250 UTILIZATION OF NEUTRON GENERATORS FOR ACTIVATION ANALYSIS IN THE CHEMICAL AND PETROLEUM INDUSTRIES. Perdijon, J. Chim. Ind. (Paris), 97: 305-9(Feb. 1967). (In French).

The principles of neutron activation analysis are described pictorially. An industrial installation (S. A. de Machines Electrostatiques) is described; this system uses the reaction between ^3H and ^2H for generation of 14-MeV neutrons, with an accelerator of 150 KV. A pneumatic transfer system is employed; γ spectrometry, using an NaI crystal with a 400-channel analyzer, is the final step. Techniques for qualitative and quantitative analysis are discussed. Several industrial methods are noted: determination of 0 in bitumens (1.3-g samples containing 0.5% to 5% O gave 3% relative precision in 5 hours for 56 samples) and P in a doped oil. Possible applications of the method are suggested after considerations of its advantages; a table lists easily determined elements, time, and possible interferences. The elements include Al, Ba, Cl, Fe, Mg, Na, O, P, and Si as likely candidates for easy study. (BBB)

33251 ON THE NONDESTRUCTIVE ANALYSIS OF SILICON AND ALUMINUM IN A COAL. Kurosawa, Ryuhei (Waseda Univ., Japan). (Nippon Kogyo Kaishi, 84: 101-8(Feb. 1968). (In Japanese).

The nondestructive determination of silicon and aluminum, components of ash in coal, was studied by application of 14-MeV neutrons, produced by the midget-type neutron generator tube. The available neutron flux of the generator is about $1.2 \times 10^5 n/cm^2/sec$ for 14-MeV neutrons and $1 \times 10^4 n/cm^2/sec$ for thermal neutrons. The sample coal and two standard samples (pure aluminum and silicon) were irradiated close together in an irradiation hole of the moderator for 10 min; each standard sample consists of 0.5g of aluminum or silicon powder dispersed in 5g of benzoic acid. The silicon and aluminum contents in a given sample coal can be determined by comparing the photopeak counts of ^{28}Al and ^{27}Mg of a given gamma ray from the sample coal with the photopeak counts of these nuclides from the same gamma ray in the spectrum of the standard sample. The relations are calculated by the following equations: $C_A = C_{SA}x + C_{AA}y$ and $C_M = C_{SM}x + C_{AM}y$, where C_A and C_M are net counts of ^{28}Al and ^{27}Mg photopeak of an irradiated coal sample, respectively, C_{SA} and C_{SM} are net counts of ^{28}Al and ^{27}Mg photopeak of unit weight of irradiated silicon, respectively, and C_{AA} and C_{AM} are net counts of Al and Mg photopeak of unit weight of irradiated aluminum, respectively. The content of silicon and aluminum in the sample coal determined by this proposed method agreed well with results given original chemical analysis. The sensitivity of this method can be evaluated as 4 mg for silicon and 12 mg for aluminum in net weight for a given sample under the following consideration: relative standard deviation of net counts of ^{28}Al and ^{27}Mg photopeak ≤20%. (NSA of Japan)

33252 NEUTRON-ACTIVATION METHOD OF ANALYSIS. Prosperi, Daniele (CNEN–CSN, Casaccia, Italy); Salvetti, Franco. Com. Naz. Energ. Nucl., Notiz., 14: 88-95(Jan. 1968). (In Italian).

The principles on which neutron activation analysis is based are examined. The characteristics of the most commonly used neutron sources are discussed. New techniques for the analysis of the γ radiation emitted and some of the more interesting industrial applications of neutron activation analysis are considered. (J.S.R.)

33253 NEUTRON ACTIVATION ANALYSIS FOR COPPER IN BIOLOGICAL MATERIAL APPLIED TO WILSON'S DISEASE. Fell, G. S.; Smith, Hamilton; Howie, R. A. (Glasgow Royal Infirmary). J. Clin. Pathol., 21: 8-11(Jan. 1968).

A method for the neutron activation analysis of Cu in biological material was described and applied to the diagnosis and management of 4 cases of Wilson's disease. The activation technique involved irradiation of the samples with thermal neutrons. Natural Cu is a mixture of 2 stable isotopes both of which undergo the (n,γ) reaction. The product ^{64}Cu produced by $^{63}Cu(n,\gamma)^{64}Cu$ gives the greatest sensitivity and was therefore chosen for this investigation. A few interfering reactions (i.e., nuclear reactions which produce Cu isotopes from other elements) were possible, such as $^{64}Zn(n,p)^{64}Cu$; $^{66}Zn(n,p)^{66}Cu$; and $^{69}Ga(n,\alpha)^{66}Cu$, but these were significant only if the material consisted largely of the interfering element. By use of a thermal neutron flux of $1.2 \times 10^{12} n/cm^2/sec$ and a 24-hr irradiation time, it was possible to estimate 10^{-9} g of Cu with an accuracy of better than 10%. This compared favorably with classical methods. The activation analysis method was of particular value when Cu estimations were desired in tissues obtained at biopsy, since the amount of material required was much less than that required by conventional analytical methods. Results for serum and urine Cu agreed with values obtained by established colorimetric techniques. The high sensitivity of the method described allowed 10^{-9} g Cu to be determined to within 10% in biopsy material such as liver, spleen, hair, and nail. (BBB)

33254 DETERMINATION OF OXYGEN IN CESIUM METAL BY VACUUM DISTILLATION METHOD. Malikova, E. D.; Dmitrieva, I. B.; Konovalov, E. E.; Desyatkina, E. A. At. Energ. (USSR), 24: 162-8(Feb. 1968). (In Russian).

A method for the determination of oxygen in metallic cesium, based on the separation of the oxide from metal by means of distillation of the metal in vacuum is described. The thermodynamic bases of the method were calculated and the optimum distillation regime (temperature, time, batch size, and crucible material) were experimentally established. Apparatus for making the analysis and auxiliary devices for preparing and refining cesium were developed and described; two variants of the apparatus were proposed. It was shown that the sensitivity of the oxygen determination in metallic cesium is $\sim 2 \times 10^{-3}$ wt %. The reproducibility of the method, evaluation of the size of the mean square error, was $\sim 1 \times 10^{-3}$% at oxygen concentrations of the order of 2×10^{-2} to 3×10^{-2} wt %. (tr-auth)

33255 FIRING DISTANCE DETERMINATION BY NEUTRON ACTIVATION ANALYSIS. Krishnan, S. S. (Centre of Forensic Sciences, Toronto). J. Forensic Sci., 12: 471-83(Oct. 1967).

A method of determination of the firing distances using neutron activation analysis (NAA) was developed for routine use. A recommended routine procedure for firing distance determination by NAA is given: first, duplicate test shots are made from suitable firing distances using the weapon, ammunition, and target used in the case, 8 concentric circles each 0.25 cm in width are cut out with the bullet holes as the center from the case shot and test shot targets, and the samples are irradiated in a nuclear reactor with a thermal neutron flux $\sim 10^{13}$ n/sec cm^2) for 12 hr. The samples are allowed to decay for 4 to 5 days, and the samples are counted by any suitable counting equipment available for the 0.56 MeV γ rays from ^{122}Sb (a 400 channel analyzer connected a NaI crystal was used). The antimony concentration vs firing distance graph is constructed using the data from test shots, the firing distance is estimated by comparison of the corresponding samples from case shots with those in the test shots, and an average firing distance value determined. The method is shown to give shooting distances with a deviation of ±2 in. in many cases. An empirical relation between the Sb concentration around the bullet hole and the shooting distance was derived. Effects of target material, bullet, weapon, and firing angle were also studied. (BBB)

33256 CHROMATOGRAPHY AND METHODS OF IMMEDIATE SEPARATION. VOLUMES I AND II. Proceedings of the Meeting held at Athens, 19–24 September 1965. Parissakis, G. (ed.). [Athens], Union of the Greek Chemists, 1966. 747p. (In several languages). (CONF-650994-(Vols.1 and 2)).

A total of 55 papers are included in the two volumes; separate abstracts were prepared for 3. The remaining 52 papers include information on: recent developments in chromatography; identification of gas chromatography fractions; new types of capillary columns and their applications under programmed temperature and flow conditions; theoretical relation between time of retention, temperature, and thermodynamics; chromatography of pyrolysis products used as a means of identification; advanced gas-liquid chromatography instrumentation; design performance of a new automatic instrument for organic elementary microanalysis; various applications of gas and gas-liquid chromatography; applications of paper chromatographic separation in activation analysis of inorganic substances; and various applications of paper and thin layer chromatography. (P.C.H.)

For abstracts of individual papers see: 33257, 33258, and 33525.

33257 APPLICATIONS OF GAS CHROMATOGRAPHY IN NUCLEAR TECHNOLOGY. Horton, A. D.; Meyer, A. S.; Kelley, Myron T. (Oak Ridge National Lab., Tenn.). pp 337-49 of Chromatography and Methods of Immediate Separation. Volume I. Parissakis, G. (ed.). [Athens], Union of the Greek Chemists, 1966.

From 3rd International Congress on Immediate Separation and Chromatography, Athens. See CONF-650994-(Vol.1).

Gas chromatography has been applied to the solution of a variety of analytical problems in nuclear technology. Both gas-liquid and gas-solid chromatography have been used. The latter has been employed primarily for the analysis of permanent gases, specifically the determination of trace impurities in helium used as a gas-cooled reactor coolant. Column packings used for this purpose include molecular sieves, silica gel, and alumina. The experimental conditions for gas-liquid chromatography have been quite diversified because of the complex and variable nature of the separations involved. Selected specific examples of applications of gas chromatography in nuclear technology are described in some detail. (auth)

33258 APPLICATIONS OF GAS-PHASE CHROMATOGRAPHY IN ATOMIC ENERGY. Darras, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 351-78 of Chromatography and Methods of Immediate Separation. Volume I. Parissakis, G. (ed.). [Athens], Union of the Greek Chemists, 1966. (In French).

From 3rd International Congress on Immediate Separation and Chromatography, Athens. See CONF-650994-(Vol.1).

Recent developments in gas chromatography are described, including: determination of gases in nuclear metals (U, Be, Zr); determination of impurities present in gaseous refrigerants, such as helium or carbon dioxide; separation and determination of fission gases (Kr and Xe) formed in fuels and partially escaping during the course of irradiation; and the determination of certain impurities (C and H) in liquid metals, such as sodium. (P.C.H.)

33259 CERIUM AND EUROPIUM CONTENT OF SOME STANDARD ROCKS. Brunfelt, A. O.; Steinnes, E. (Univ. of Oslo). Chem. Geol., 2: 199-207(Sept. 1967).

A neutron activation technique and radiochemical separation procedure are described for determination of Ce and Eu in geological samples. By selecting appropriate time intervals for neutron irradiation and cooling, advantage was taken of the half-life of the 32 day ^{141}Ce nuclide and of the 2 long-lived europium nuclides 12.4 yr, 16 yr ^{152}Eu, ^{154}Eu formed by (n,γ) reactions. The relevant nuclear data are shown. After decomposition of the irradiated rock specimens by fusion with sodium hydroxide, the melt was dissolved and hydroxide precipitation performed. The precipitate was dissolved in a mixture of nitric acid, ethanol, and water. A chromatographic fractionation procedure by anion-exchange resin (Dowex 1 X8, 100 to 200 mesh) was developed for separation of Ce and Eu from this mixture. After the adsorption of the ions, the resin was washed with 20 ml of the mixture 10% (v/v) nitric acid–70% ethanol–20% water. Europium was then eluted with 20 ml of 10% nitric acid–50% ethanol–water, and the still-retained Ce with 20 ml of water. Relative to an average chondritic distribution, both Ce and Eu appeared to be normal in all the rocks studied, except for granodiorite GSP-1, in which Eu was found to be significantly depleted. (BBB)

33260 INVESTIGATION OF CRIMES ETC. BY ACTIVATION ANALYSIS. Kobayashi, Masatoshi (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo, 13: No. 12, 43-6(Dec. 1967). (In Japanese).

A description, and relevant discussion, is made of the studies made by P. Guinn for the activation analysis of paints, plastics, rubber, etc., and of the studies by R. E. Jervis for hair, fingernails, etc. Studies for the determination of the Hg content in hair in connection with an agricultural–chemical problem, and for the composition analysis of an oil painting, are described. The latter study was successful in identifying imitated paintings. (NSA of Japan)

33261 AN INTERNAL-MONITOR METHOD FOR THE ACTIVATION ANALYSIS OF SILVER IN PALLADIUM WITH THERMAL NEUTRONS. Oka, Yoshinaga; Kato, Toyoaki (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 41: 329-33(Feb. 1968).

An internal-monitor method was developed to eliminate many of the errors probable with activation analysis. This method involves measurement of the radioactivity of the species to be analyzed and of an appropriate internal-monitor, and estimation of the ratio of the induced activity of both the species. The principles and the applicability of the method to the determination of a trace amount of silver in palladium by means of thermal neutron irradiation are considered. After the silver activity is chemically separated from the irradiated sample, the γ spectrum corresponding to the mixture of ^{110m}Ag and ^{111}Ag formed by the β^- decay of ^{111}Pd is measured. Synthetic mixtures of silver and palladium with known weight ratios were prepared to check the accuracy of the method. A good proportionality was obtained between the ratios of the ^{110m}Ag to ^{111}Ag activities and the ratios of the concentrations. By using this relationship, silver analysis can easily be achieved. Contents of silver in a palladium sample down to about 1 ppM can be determined with a relative error of within ±2%. By this method the errors that arise from neutron flux irregularities and self-shielding effects can be avoided, and no correction for chemical yield is necessary. (NSA of Japan)

33262 ADAPTATION OF COLORIMETRIC DETERMINATION OF URANIUM BY THE DIBENZOYLMETHANE METHOD USING THE TECHNICON AUTOANALYZER. Fremeaux; Cattin (Com-

missariat a l'Energie Atomique, Paris). Chim. Anal. (Paris), 50: 34-9(Jan. 1968). (In French).

An automatic method for determining U in nitrate solutions with the auto-analyzer is described; it is a modification of the manual procedure, an extraction of the U-dibenzoylmethane complex with CCl_4 and photometric analysis at 420 nm. Practical upper and lower limits are 1 and 10 μg/ml; at 1, 5, and 7 μg levels, the standard deviations are 2.7×10^{-3}, 4.4×10^{-3}, and 6.7×10^{-3}, and the precisions for one determination are 8, 2.5, and 2.7%. Interfering ions, all at concentrations above 2 g/l, are Cl^-, PO_4^{3-} and other phosphate ions, SO_4^{2-}, F^-, Th, Zr, Ti, Cr, and Mo. Al and Ni interfere in special ways, the Ni beginning at 0.5 g/l. When the method was compared with the thiocyanate method for U, the absolute deviation at the 95% confidence level was −0.001 ± 0.006%. (BBB)

33263 NITROGEN AND OXYGEN DETERMINATION IN URANIUM MONONITRIDE. **Hein, Wolfgang; Schneider, Helga; Schumann, Hannelore (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Z. Anal. Chem., 237: 330-9(1968). (In German).**

Uranium mononitride samples were analyzed with a wet-chemical method (dissolving in HCl with H_2SiF_6) according to Kjeldahl and with a modified vacuum-fusion method for their nitrogen content. The nitrogen values found by both methods show good agreement, the standard variations of both methods were small. In some cases the BMI-method (oxidizing dissolution with copper selenate) showed too low nitrogen values. In the case of vacuum-fusion method the oxygen values were found at the same time with satisfying precision. (auth)

33264 GRAVIMETRIC ESTIMATION OF ZIRCONIUM USING 3-NITROPHTHALIC ACID. **Geetha, S.; Joseph, P. T. (Univ. of Kerala, Trivandrum, India). Indian J. Chem., 6: 169(Mar. 1968).**

Gravimetric estimation of zirconium in pure salts as well as in zircon was carried out using 3-nitrophthalic acid. The results obtained are comparable to those obtained with mandelic acid. Al (III), Fe(III), F^-, and SO_4^{2-} seriously interfere with the estimation and, therefore, should be absent. (auth)

33265 DETERMINATION OF CADMIUM IN THORIUM NITRATE BY LINEAR CHRONOAMPEROMETRY WITH ANODIC REDISSOLVING. **Khasgiwale, K. H. (AEET, Bombay); Molina, R. J. Electroanal. Chem., 13: 144-8(1967). (In French).**

Linear chronoamperometry by anodic stripping was applied to the determination of cadmium in solutions of thorium nitrate with K_2CO_3 or KCl−HCl as supporting electrolyte. The effect of supporting electrolyte concentration on the oxidation current is discussed. (auth)

33266 ELECTROMETRIC DETERMINATION OF NEODYMIUM(III) AS TUNGSTATE. **Joshi, M. P.; Gupta, C. M. (Univ. of Rajasthan, Jaipur, India). Indian J. Chem., 6: 118-19(Feb. 1968).**

A rapid amperometric method for determination of Nd^{3+} was described, which consists of titrating it against sodium tungstate solution at $E_{d.e.} = -1.85$ V (versus SCE). The method permits determination of neodymium (lower limit 0.5 mM) with an accuracy of ±1.6%. (auth)

33267 RAPID DETERMINATION OF URANIUM DIOXIDE IN URANIUM PHOSPHIDES. **Driscoll, J. L.; Evans, P. E. (Univ. of Manchester, Eng.). Analyst, 93: 403-5(June 1968).**

A rapid gravimetric method for the determination of uranium dioxide in uranium monophosphide and triuranium tetraphosphide is described. The phosphide compounds are dissolved in an ethyl acetate−hydrochloric acid solution and the remaining uranium dioxide oxidized in air to triuranium octoxide. A precision of ±0.2 percent w/vol is claimed for each determination. (auth) (UK)

33268 DETERMINATION OF THE ACTIVITY OF ISOTOPES BY ACTIVATION ANALYSIS USING A SPECIAL SYSTEM OF COORDINATES. **Blankov, E. B.; Blankova, T. N.; Rusyaev, V. G. Zavod. Lab., 34: 305-7(1968). (In Russian).**

A method for the determination of the activity of isolated isotopes during activation analysis with use of a special system of coordinates, rectifying the two-component decay curve induced activity, was proposed. The method is the most convenient in cases where the separated isotopes are characterized little by the half-life, and the efficiency of the spectral selection is insufficient. The system of coordinates was used for the determination of low activities of vanadium in a background of interfering Al radiation. (tr-auth)

33269 ACTIVATION ANALYSIS OF CHROMIUM, SILICON, NICKEL, TUNGSTEN IN ALLOYS BY USING A NEUTRON GENERATOR. **Barwinski, A.; Buczek, A.; Gorski, L.; Janczyszyn, J.; Kwiecinski, St.; Loska, L. (Institut fuer Kerntechnik, Krakow). Isotopenpraxis, 4: 15-19(Jan. 1968). (In German).**

An entirely instrumental activation analysis technique for determination of chromium, silicon, nickel, tungsten, and oxygen in alloys in the percent range of concentration is described. Activation was carried out by means of fast neutrons from a neutron generator, except for tungsten, which was activated by thermal neutrons from a Ra−Be source. The relative accuracy of the determinations is 3 to 4%. (auth)

33270 RESONANCE NEUTRONS IN ACTIVATION ANALYSIS. PART 2. DETERMINATION OF GOLD IN BIOLOGICAL MATERIAL BASED ON THE ANALYSIS OF DECAY CURVE. **Rakovic, M.; Prouza, Z. (Karlova Univ., Prague). Isotopenpraxis, 4: 11-15(Jan. 1968).**

The gold in biological material is determined on the basis of the selective activation and decomposition of the decay curve. The selective activation is carried out in the core of the nuclear reactor. Before activation the samples are covered with the Cd foil. The decay curve is obtained by integral measurement using a scintillation counter and eliminating beta rays by filters. (auth)

33271 DETERMINATION OF CERIUM IN FISSION PRODUCTS BY EXTRACTION WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID. **Krtil, J.; Bezdek, M.; Mencl, J. (Inst. of Nuclear Research, Rez, Czech.). Z. Anal. Chem., 235: 401-13(1968). (In German).**

The extraction of cerium, oxidized to the tetravalent state, from nitric acid medium by bis(2-ethylhexyl) phosphate in hexane was studied. The effects of nitric acid concentration, agent concentration, oxidizer amount, and carrier concentration on the yield of cerium extraction was investigated and the optimum conditions of the extraction were found. Under these conditions, the reproducibility of the method was determined and the extraction of other fission products (Sr, Cs, Zr, and Ru) was also tested. The procedure was verified by the determination of cerium in artificial and real mixtures of fission products. (auth)

33272 POLAROGRAPHIC DETERMINATION OF MOLYBDENUM IN PRESENCE OF OTHER METALS. **Holzapfel, Heinz; Guertler, Oswald; Tempel, Brunhilde (Karl Marx-Univ., Leipzig). Z. Anal. Chem., 235: 413-18(1968). (In German).**

A polarographic method for the determination of molybdenum in the presence of other metals is described. Molybdenum(VI) yields a well-defined cathodic wave in ammonium tartrate medium (0.25 $\underline{M}$) at $E_{1/2} = -1.27$ V vs SCE (standard calomel electrode). The results obtained have been applied to the determination of molybdenum in ores (error ± 1%) and alloys (error − 2%). The interfering influence of greater amounts of chromium(VI) is eliminated by ion-exchange with the strongly basic anion-exchanger Wofatit SBW. A ten-fold excess of W(VI), Mn(II), Ni(II), Cu(II), and Tl(I) as well as equal amounts of Fe(II), Fe(III), Cd(II), Co(II), V(V), and Bi(III) do not interfere. (auth)

33273 PRESENT STATE OF COMPLEXOMETRY. III. DETERMINATION OF UNIVALENT METALS. **Pribil, Rudolf (Heyrovsky Polarographic Inst., Prague). Talanta, 14: 613-18(June 1967).**

A review of the visual complexometric determination of univalent metals is presented. Because of the low complex-forming tendency of these metals, all methods are based on indirect determinations such as displacement reactions, or precipitation of the univalent metal in a form which can be determined complexometrically. Metals covered include Ag, Hg(I), Tl(I), Li, K, Na, Rb, and Cs. (auth) (UK)

33274 PREPARATION OF LIQUID SCINTILLATION MIXTURES FOR THE MEASUREMENT OF ^{14}C AND ^3H SAMPLES. **Roberts, W. A. (Beckman Instruments Ltd., Fife, Scotland). Lab. Pract., 17: 703-6(June 1968).**

A selection of suitable materials for liquid scintillation is described. Mixtures for the measurement of a wide range of ^{14}C- and tritium-labelled samples are given. Included are samples soluble in organic solvents, samples in aqueous solution, and samples which are insoluble. (auth) (UK)

33275 RECENT APPLICATIONS OF RADIOISOTOPES IN THE CHEMICAL AND PETROCHEMICAL INDUSTRIES. **Caldera, Pier Giorgio. Com. Naz. Energ. Nucl., Notiz., 14: 95-6(Jan. 1968). (In Italian).**

A recent use of radioisotopes is the determination of silicochloroform in a hydrogen−silicochloroform mixture. This application is based on the fact that x rays emitted from a radioactive source are more strongly absorbed by elements with high atomic number. Radioactive tracers are used for control of the residence of materials in the plant, measurement of passage time of materials in various parts of plants, determination of mixing efficiency, and control of filtration efficiency. (J.S.R.)

33276 NEUTRON ACTIVATION ANALYSIS FOR IRIDIUM, PALLADIUM AND SILVER IN PLATINUM. **de Gracia Cilindro, Leodegario. Iowa City, Iowa, Iowa State Univ., 1967. 112p.**

Thesis.

A sensitive procedure for the simultaneous determination of trace amounts of iridium, palladium, and silver in a platinum stock by thermal neutron activation analysis utilizing gamma spectrometry was developed. One hundred milligram samples of platinum metal powder and irradiation standards in submilligram amounts of the elements to be determined were irradiated for periods of up to 30 hours with a thermal flux of about 3×10^{13} neutrons/cm^2-sec. The radiochemical separation scheme involved selective elution of the chloro complexes of the elements of interest through a strongly basic anion exchange resin column, followed by further decontamination methods. The activities of 14-hour ^{109}Pd, 74-day ^{192}Ir, and 253-day ^{110m}Ag were monitored by accumulation of counts in a 400-channel pulse height analyzer using a 3" diameter NaI(Tl) crystal detector. Dead time losses during counting were automatically compensated by the analyzer. The activity of ^{109}Pd in some samples contaminated with the matrix activities was evaluated by resolution of the decay curves. Corrections for counting geometry, coincidence counting losses, background, radioactive decay and chemical yields were considered. Average impurity contents of 15 ± 2.1 ppB of iridium in 12 analyses, 28 ± 4.3 ppB of palladium in 8 analyses, and 2.4 ± 0.27 ppM of silver in 6 analyses, were obtained for the platinum stock investigated. The concentration level of palladium obtained seemed to approach the limit of detection of this element in a platinum matrix, on the basis of the radiochemical separation and instrumentation used. The over-all errors in the results appeared to be mostly due to uncertainties inherent in gamma spectrometry. The errors due to self-shielding during irradiation, and the interferences arising from secondary neutron reactions and threshold reactions, were deemed insignificant. (Disser. Abstr.)

33277 ISOTOPE DILUTION. Broda, E. (Univ. of Vienna). Chimia (Aakau), 21: 8-15(1967). (In German).

A review is presented of the applications of this procedure in radioactivation analysis. (56 references.) (Anal. Abstr.)

33278 MASS-SPECTROMETRIC DUAL COLLECTOR FOR PRECISE STRONTIUM ISOTOPE ABUNDANCE RATIO MEASUREMENTS. Hayatsu, A.; Farquhar, R. M. (Univ. of Toronto). J. Sci. Instrum., 44: 141-5(1967).

A simple dual collector is described that was developed for use with an A.E.I. MS2 mass spectrometer. The mean value and standard deviation of normalized ratios of ^{87}Sr to ^{86}Sr from 10 replicate analyses on a standard solution are 0.7126 and ±0.003, respectively. (Anal. Abstr.)

33279 DETERMINATION OF MOLYBDENUM IN MILK WITH ZINC DITHIOL. Stanton, R. E.; Hardwick, A. J. (Imperial Coll. of Science and Tech., London). Analyst, 93: 193(Mar. 1968).

A method for the determination of Mo in soils and sediments (Analyst 92: 387 (1967)) was applied to milk. Standards were prepared with 4 $\underline{M}$ H_2SO_4 instead of 6 $\underline{M}$ HCl, and without addition of iron. Calcium sulphate interfered when in suspension, there being visible sorption of the Mo-dithiol complex by the precipitate. Recovery of Mo was complete in the presence in the milk of the equivalent of 0.1% of both Ca and P, provided the calcium sulphate was allowed to settle. (UK)

33280 DETERMINATION OF ZIRCONIUM, NIOBIUM, TITANIUM, AND VANADIUM IN THE MICROGRAM REGION IN CORROSION MEDIA (CONDENSER WATER AND SODIUM SULFATE) WITH THE HELP OF X-RAY FLUORESCENCE ANALYSIS. Schneider, Helga; Schumann, Hannelore (Kernforschung mbH, Karlsruhe, Ger.). Z. Anal. Chem., 235: 160-6(1968). (In German).

A method is described for the determination of microgram amounts of Zr, Nb, Ti, and V in corrosion water and sodium sulfate. The elements are precipitated by means of cuferron from a 10% H_2SO_4 solution in the presence of tartaric acid and of 2.5 mg of Fe as trace collector. After ignition of the precipitate the oxides obtained are analyzed by x-ray fluorescence spectrometry. The intensities of the single elements are measured at the Kα lines taking into account the respective back-ground and referring to the intensity of the iron which is used as internal standard. The limits of detection are below 1 μg. The error involved in the procedure is also below 1 μg. The method can therefore be recommended for an accurate determination of the above elements in microgram or parts per million-range. (auth)

33281 SPECTROCHEMICAL DETERMINATION OF ISOTOPE RATIO OF OXYGEN BY MICROWAVE DISCHARGE METHOD. Kamada, Hitoshi; Oda, Shohei (Tokyo Univ.). Bunseki Kagaku, 17: 469-74(Apr. 1968). (In Japanese).

The isotope ratio of oxygen ($^{16}O/^{18}O$) in the form of carbon monoxide was determined by spectrometry using a microwave discharge. The intensity ratio of the CO^+ band ($B^2\Sigma \rightarrow {}^2\Sigma$, 2445.8 Å) and its shifted isotope band was measured. The stable CO^+ band with the highest intensity was obtained at a concentration of 2 vol % carbon monoxide in helium atmosphere. The analytical curve was prepared for standard samples, isotope ratios of which were determined by mass spectrometry. The standard deviation of the result was about 2% for 35% of $C^{18}O$. The results were not affected by the coexisting nitrogen and hydrogen. (NSA of Japan)

33282 POLAROGRAPHIC ESTIMATION OF URANIUM(VI) AT THE DROPPING MERCURY ELECTRODE IN PHOSPHORIC ACID. Malik, Wahid U.; Gupta, Hari Om; Sharma, Chokhey Lal (Univ. of Roorkee, India). J. Electroanal. Chem., 14: 239-40 (1967).

The polarographic wave of uranium in 1.0 to 4.0$\underline{M}$ phosphoric acid containing about 0.3$\underline{M}$ neutral salts was observed. The wave shape corresponded to the equation for a reversible one-electron process. (M.C.G.)

33283 DETERMINATION OF TELLURIUM IN EVAPORATED THIN FILMS OF MERCURY, CADMIUM, AND TELLURIUM BY SINGLE-SWEEP POLAROGRAPHY. Whitnack, Gerald C.; Donovan, T. M.; Ritchie, Milton H. (Naval Ordnance Test Station, China Lake, Calif.). J. Electroanal. Chem., 14: 205-8(1967).

A rapid and reliable single-sweep polarographic method of analysis is described for tellurium in evaporated HgTe and CdTe thin films and in evaporated films of mercury–cadmium telluride systems. The procedure is simple and should be applicable to a large number of alloy films and other materials containing tellurium, with only slight modification. A comparison of polarographic and photometric results for tellurium are presented. (auth)

33284 ANALYTICAL CONTROL OF GASES IN METALS OF NUCLEAR INTEREST. del Milagro Perez, M. Energ. Nucl. (Madrid), 11: 537-48(Nov.-Dec. 1967). (In Spanish).

The classical methods used for analysis of gases in metals are extraction by vacuum fusion, fusion and gas carriers for removal of impurities, and extraction by heating in a vacuum. The application of each of these methods to the analytical control of gases in metals is described and typical analytical installations are given. The most commonly used recently developed methods are gas chromatography, emission spectrometry, and radioactivation. These are described in much less detail than the classical methods. (J.S.R.)

33285 2', 3', 4'-TRIHYDROXY CHALCONE AS AN ANALYTICAL REAGENT FOR NIOBIUM AND TANTALUM. Naidu, R. Raghava (S. V. Univ. Coll., Tirupati, India). Curr. Sci. (India), 37: 342(June 20, 1968).

Gravimetric estimations of niobium and tantalum were made using 2', 3', 4'-trihydroxychalcone. The chalcone complexes could be dried to constant weight and the results were reproducible. (M.C.G.)

33286 SYSTEMATIC RADIOACTIVATION ANALYSIS OF TRACE ELEMENTS IN RICE PLANTS. DETERMINATION OF HALOGEN ELEMENTS. Kusaka, Yuzuru; Tsuji, Haruo (Konan Univ., Japan). Radioisotopes (Tokyo), 17: 108-12(Mar. 1968). (In Japanese).

Samples of seed, stem, leaf, chaff, and grain (0.5g) collected from a batch of rice plants were activated with thermal neutrons in an atomic reactor for 30 min. After activation the samples were decomposed by a concentrated H_2SO_4 and concentrated HNO_3 mixture together with KCl, KBr, and KI carriers. During the process the distillate was absorbed in a cold 5 $\underline{N}$ NaOH solution. Iodine was then isolated by a reduction procedure with hydrazine sulfate followed by oxidation with sodium nitrite in nitric acid medium, and extracted into a CCl_4 phase. Gamma spectrometry of ^{128}I was performed on the AgI precipitate obtained through a back-extraction of iodine from the CCl_4 to an aqueous phase containing Na_2SO_3. For the other two elements a mixed precipitate of AgBr and AgCl was produced from the remaining aqueous phase after the iodine extraction. The gamma spectrum of ^{38}Cl was measured immediately. After the ^{38}Cl decay, which is a one day interval, a spectrum of ^{82}Br could be measured on the same precipitate. The chemical yields were more than 50% for iodine and almost quantitative for bromine and chlorine, and the separation was about 40 min for iodine and 90 min for the others. The method has elucidated some interesting metabolic effects on the distribution of halogen elements in organs of rice plants that chlorine tends to be concentrated in seed, especially in grain, and bromine and iodine in leaf. The method can be combined with the previous one for Mn, Mg, K, Na, Cu, and Zn, reported previously, Vol. 16, No. 10, p. 526, 1967, to make a sequential activation analysis for these elements. (NSA of Japan)

33287 COLORIMETRIC DETERMINATION OF ZIRCONIUM IN ALLOYS WITH THE REAGENT ZIRCONIN [GALLOCYANINE MS].

Mustafin, I. S.; Shchukina, V. S. (Chernyshevskii Saratov Univ., USSR). Zavod. Lab., 33: 12-14(1967). (In Russian).

In $\underline{N}$-HCl, gallocyanine MS (I) [the preparation from gallocyanine (C.I. Mordant Blue 10) is described] forms a H_2O-soluble 1 : 1 complex with Zr; maximum absorption is at ≃610 nm, and Beer's law is obeyed for 1 to 30 μg of Zr in 10 ml. There is no interference from alkali and alkaline-earth metals, Cd, Zn, Mn, Ni, Co, Pb, Cu, Al, Y, La, NO_3^-, SO_4^{2-}, and acetate, but F^-, oxalate and VO_3^-, and more than 100 parts of Ti, U, Sc, Cr, As, and Bi, 50 parts of Th and Ge, 20 parts of Be, 15 parts of Fe(III), 10 parts of Mo, W, and Sb(III) 3 parts of Sn(II) and PO_4^{3-}, and 0.1 part of Nb to 1 of Zr interfere. For Mg- and Al-based alloys, the sample (0.5 to 1 g) containing 0.05 to 0.9% of Zr is dissolved in 20 ml of HCl (1 : 1). The cooled solution is diluted to 100 ml, an aliquot (0.5 to 5 ml) is treated with 0.5 ml of 0.05% aq. I, the mixture is diluted to 10 ml with $\underline{N}$-HCl, and the extinction is measured at 610 nm against an equimolar solution of the reagent in $\underline{N}$-HCl. For Ni- and Cu-based alloys, the sample is dissolved in 20 ml of HNO_3 (1 : 1) and oxides of N are removed by boiling; the solution is then analyzed as before. For Zr-based alloys containing Ti and Nb, the sample (0.05 g) is treated with 5 ml of H_2O and dissolved in 2 ml of HF (1 : 5) in the cold. The solution is heated to fumes with 1 ml of H_2SO_4 for 10 to 15 min, and this operation is repeated to remove HF after the addition of 5 to 6 ml of H_2O and a further 1 ml of H_2SO_4. The cooled solution is diluted to 100 ml with 2$\underline{N}$ HCl, and a 2-ml portion is diluted to 50 ml acidity 0.1$\underline{N}$ in HCl). An aliquot (0.5 to 2 ml) of this solution is treated as described above. Alternatively, a difference photometric determination in 6$\underline{N}$-HCl against a solution containing 1 mg of Zr in 50 ml is carried out. (Anal. Abstr., Vol. 15, April 1968)

33288 INVESTIGATION OF ISOTOPE ANALYSIS BY ACTIVATION ANALYSIS. IN THE CASE OF COEXISTENT INDICATOR SYSTEM ^6Li–^{55}Mn. Shinagawa, Mutsuaki (Osaka Univ.); Oyoshi, Akira. Radioisotopes (Tokyo), 17: 103-7(Mar. 1968). (In Japanese).

The determination of ^6Li was carried out by the coexistent indicator method. The coexistent system of ^6Li–^{55}Mn was irradiated by thermal neutrons which would be preferentially captured by ^6Li before causing (n,γ) reaction of ^{55}Mn. Therefore, induced activity of ^{55}Mn depended on the content of coexistent ^6Li. The thermal neutron flux was $10^4 n \cdot cm^{-2} \cdot sec^{-1}$. Cadmium ratio was 10.4. Natural Li (abundance ratio of ^6Li : 7.42%) was used as a standard sample. The relation between activity of ^{55}Mn, y (cpm), and ^6Li concentration, x (mg) for 5 ml of 2 $\underline{M}$ $MnSO_4$ was obtained as follows: $\log y = -0.012\, x + 4.673$. (NSA of Japan)

33289 ANALYTICAL SEPARATIONS USING CHELATING ION EXCHANGE AND PARTITION CHROMATOGRAPHY. Schmitt, Donald Henry. Contract W-7405-eng-82. Iowa City, Iowa, Iowa State Univ., 1967. 83p. (IS-T-174).

Thesis.

Uranium(VI) was separated quantitatively from most other metal ions by partition chromatography on a silica gel column. The column was treated with aqueous 6$\underline{M}$ nitric acid; after sorption of the sample, uranium(VI) was selectively and rapidly eluted by methyl isobutyl ketone. In addition to the separation of macro quantities of metal ions, the method was used successfully for the isolation of trace amounts of metal ions from uranium (VI). A study was made of cellulose phosphate as a chelating ion exchanger in an aqueous hydrochloric acid system. Weight distribution coefficients for the rare earths, alkaline earths, alkali metals, and a few other metals were determined. Successful separations of rare earths and alkaline earths, alkaline earths and alkali metals, and aluminum and alkaline earths were achieved on cellulose phosphate columns. The components of complex samples, one containing uranium, erbium, and magnesium and the other uranium, aluminum and nickel, were quantitatively separated by combining the two methods. (Disser. Abstr.)

33290 GRAVIMETRIC DETERMINATION OF URANIUM WITH 3-AMINOBENZOIC ACID AND 1,10-PHENANTHROLINE. INDIRECT DETERMINATION BY TITRATION OF THE AMINO-ACID OF THE COMPLEX WITH SODIUM NITRITE. Ripan, R.; Sacelean, V. (Institutul de Chemie, Cluj). Rev. Roum. Chim., 12: 17-20(1967). (In French).

To prepare the reagent, dissolve 3 g of 1, 10-phenanthroline hydrate ($I.H_2O$) and 4 g of 3-aminobenzoic acid (II) in 1 liter of hot water, and filter; prepare a rinsing solution by sixfold dilution of this solution. Adjust the pH of the test solution (60 ml) containing UO_2^{2+} to ≃4 with aqueous NH_3, heat to 90 to 95°, add the reagent solution (at least 60 ml for <60 mg of U), and heat almost to boiling. Shake the vessel for 2 or 3 min to convert the initial voluminous yellowish-white precipitate into lemon-yellow crystals, and after at least 5 min collect the crystals on a porcelain crucible, washing the vessel with the rinsing solution at 60 to 70° and washing the precipitate with 10 to 15 ml of the rinsing solution. Dry the precipitate for 15 to 20 min at 110 to 130°, and weigh it. The error decreases from ±1% to ±0.2% with increase in the amount of U from 11.6 to 116 mg in the 60-ml sample. Alternatively, collect the crystals on filter-paper, wash them as before and then wash them with 10 to 15 ml of 0.2% I solution at 60 to 70° (to remove II). Digest the precipitate and paper with 20 ml of $\underline{M}$-HCl until dissolved add 1 g of KBr (as catalyst) and 0.4 ml of 0.1% aqueous. Tropaeolin 00 (C.I. Acid Orange 5), and titrate with 0.1 $\underline{M}$-$NaNO_2$ until the color changes from violet to greenish-yellow. The error is ±1.2% for 90.5 to 116 mg of U. Use the gravimetric method for determination of semi-micro amounts of U, and the volumetric method for series of samples. (Anal. Abstr., Vol. 15, April, 1968)

33291 ISOTOPIC ANALYSIS OF NITRATES LABELLED WITH ^{15}N. Lantelme, F.; Chemla, M. (Faculte des Sciences, Orsay, France). Bull. Soc. Chim. Fr., No. 4, 1314-15(Apr. 1968). (In French).

A measurement of the isotopic ratio $^{14}N/^{15}N$ for mineral nitrates was carried out by mass spectral analysis of the nitric oxide obtained by reducing nitrates in a sulfuric acid medium. This simple procedure avoids the risks of contamination caused by atmospheric nitrogen. The minimum quantity of nitrates necessary for a measurement is on the order of 0.1 μ mole; the ratio $^{14}N/^{15}N$ can be determined with an accuracy of 0.5%. The conditions for applying this method are discussed in detail. (auth)

33292 TITRIMETRIC MICRODETERMINATION OF SAMARIUM AND NEODYMIUM. Saxena, O. C. (Univ. of Allahabad, India). Microchem. J., 13: 222-6(June 1968).

Titrimetric microdetermination of samarium and neodymium is described with sodium rhodizonate. Trivalent salts of samarium and neodymium form violet colored complexes in the ratio of 1 : 3. The complex is dissolved in dilute acid and the rhodizonic acid that is attached with the metal ion is estimated by titrating against a standard solution of ceric sulfate using N-phenyl anthranilic acid as indicator. Interference of cations was observed. (auth)

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Refer also to abstracts 33208, 33239, 33443, 33517, 33534, 35726, 35732, and 35737.

33293 (ARH-SA-12) REDUCTION OF PLUTONIUM(VI) TO PLUTONIUM(V), (IV), AND (III) BY NITRITE IN A NITRATE SYSTEM. Colvin, C. A. (Atlantic Richfield Hanford Co., Richland, Wash.). May 31, 1968. Contract AT(45-1)-2130. 9p. (CONF-680608-1). Dep. CFSTI.

From American Chemical Society Meeting, Portland, Ore.

Reaction rate studies involving the reduction of Pu(VI) by nitrate in low nitric acid resulted in four valence states simultaneously apparent in many of the solutions. Quantitative determinations of each valence state vs time were made by use of a recording spectrophotometer. Plutonium(VI) may be reduced to greater than 80% plutonium(III) by nitrite in a nitrate system. Intermediate solutions indicated a plutonium(V) content of as much as 76%. Valence state distribution is dependent on acidity, temperature, nitrite concentration, ferric ion concentration, and time. Gross amounts of metal ions such as uranyl ion sharply accelerate the reaction rate and thus result in rapid reduction to Pu(IV), which is the ultimate end product for all of the systems studied. Efficient reduction by nitrite is limited to solutions below 1.5 $\underline{M}$ HNO_3 and temperatures above 45°C. (auth)

33294 (NLCO-TR-9) UF_4–UO_2 BINARY SYSTEM. Khripin, L. A.; Lukyanova, L. A. Translated by George Brodi (National Lead Co. of Ohio, Cincinnati), from Izv. Sib. Otd. Akad. Nauk SSSR, No. 3, Ser. Khim. Nauk, No. 1, 131-3(1966). 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 5874. (P.C.H.)

33295 (ORNL-TM-1809) THE PROCESSING OF ThO_2 AND UO_2 SOL–GEL MATERIALS. Weaver, C. F.; Hess, D. N.; McDuffie, H. F.; Rainey, W. T.; Soldano, B. A. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 60p. Dep. CFSTI.

ThO_2–UO_2 (3 mole %) gels when heated gave off gases the quantity and nature of which depended strongly on particle size. The reversible adsorption of CO_2 on finely divided gel was studied over the temperature range from 250 to 1000°C. A method was developed to reduce the surface area of the gel and, thus, reduce the amount of gas that it could release in service. The sol-gel ThO_2 microspheres also yielded gases on heating. The largest amount of gas evolution occurred in the following centigrade temperature intervals: (240 to 260), (400 to 460), and (700 to 760). Organics were essentially eliminated at 260°C, and most of the gas was either CO_2, Co, or H_2. Attention was then turned to UO_{2+x} sol-gel microspheres. It was found that H_2O vapor carried by an inert gas (He or Ar) was very effective in the removal of the carbonaceous materials, that their removal was essentially complete at 550°C, and that this removal could be monitored with a Hydrocarbon Analyser. Densification of the microspheres was achieved by sintering with H_2O + Ar in the temperature range from 550 to 1000°C. Two hours at 850°C was sufficient. Reduction of O/U ratio to two was accomplished with H_2 in the temperature range 550 to 1000°C. One hour at 850°C was found to be sufficient. (auth)

33296 (TID-24524) PYROLYSIS AND CHROMATOGRAPHIC ANALYSIS OF URANIA GELS AND BEADS. Final Report. Technical Report No. 35. Im, S. J.; Choi, I. K.; Olson, F. A.; Wadsworth, M. E. (Utah Univ., Salt Lake City. Inst. of Metals and Explosives Research). Jan. 31, 1968. Contract W-7405-eng-26, Subcontract 2176. 39p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

Qualitative and semiquantitative analyses were made of the gases evolved by pyrolysis of urania gels and beads. Samples were heated incrementally in the temperature range from 100 to 680°C in a pyrolysis unit connected to a gas chromatograph. In addition to gas chromatography, infrared spectroscopy and mass spectrometry were employed to characterize the off-gases. The principal gases from the urania gels and beads were carbon dioxide and carbon monoxide. Both gas chromatography and mass spectrometry indicated that N_2O, NO_2, H_2O, HCOOH, CH_3OH, and HCHO were evolved by pyrolysis of urania beads, and that N_2O, NO_2, H_2O, and HCOOH were evolved by pyrolysis of urania gels. Ethylene gas was present in the gases evolved from urania beads. The mass spectrometer also indicated the presence of hydrocarbons such as methane, ethane, and aerolein in the off-gases from beads. (auth)

33297 SOLUBILITY OF AMERICIUM(III)CHLORIDE IN CONCENTRATED LITHIUM CHLORIDE SOLUTIONS. Marcus, Y. (Univ. of California, Berkeley. Hebrew Univ., Jerusalem). Radiochim. Acta, 8: 212-14(Dec. 1967).

The solubility of americium(III)chloride in concentrated lithium chloride solutions was determined. The results for 25 and 40°C were approximately the same, the solubility decreasing from ~0.11M at 9M LiCl to ~0.04M at 13M LiCl. The results are consistent with the presence of $AmCl_2^+$aq. as the major soluble species of americium in these solutions, but do not rule out other possibilities. (auth)

33298 TUNGSTEN BRONZE FUEL CELL CATALYSTS. Broyde, Barret (Esso Research and Engineering Co., Linden, N. J.). J. Catal., 10: 13-18(Jan. 1968).

The rare earth tungsten bronzes and several transition metal–tungsten mixed oxides were found to catalyze the electrochemical oxidation of hydrogen in acid media. Their activity is associated with a high magnetic susceptibility. These systems, and other acid stable, electrically conductive tungsten bronzes and oxides are able to catalyze the reduction of oxygen. The limitations of the electrode structure that was used are discussed. (auth)

33299 URANIUM–TELLURIUM SYSTEMS. Slovyanskikh, V. K.; Yarembash, E. I.; Ellert, G. V.; Eliseev, A. A. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 624-6(Apr. 1968). (In Russian).

A phase diagram and x-ray phase analysis of the U–Te system section with 58 to 78 at. % Te revealed that uranium sesquitellurides have a cubic lattice with the structure identical to Th_3P_4 and uranium ditelluride has a tetragonal lattice. Data are included for homogeneous U_3Te_5 and U_3Te_7 regions. (R.V.J.)

33300 VOLATILE DOUBLE ALKOXIDES OF LANTHANONS. Mehrotra, R. C.; Agrawal, M. M. (Univ. of Rajasthan, Jaipur, India). Chem. Commun., 8: 469-70(1968).

The preparation is reported of some double alkoxides of La and Pr with Al by the following reaction in isopropyl alcohol: $MCl_3 \cdot 3$ iso-PrOH + 3 KAl(O iso-Pr)$_4$ → M[Al(O iso-Pr)$_4$]$_3$ + 3 KCl (where M is La or Pr). Some properties of these compounds are given, and a tentative structure is suggested. (UK)

33301 SOL-GEL PROCESS. Hermans, M. E. A.; Van der Plas, Th. (KEMA, Arnhem, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 28, 59-69(1968). (In Dutch).

The different methods used to obtain gels of UO_2–ThO_2 particles in various sizes in water are explained. The procedures used to transform sols into gels are outlined. (J.J.t B.)

33302 CATALYTIC HYDRATION AND DEUTERATION OF STEROIDS IN THE HOMOGENEOUS PHASE. Voelter, Wolfgang; Djerassi, Carl (Stanford Univ., Calif.). Chem. Ber., 101: 58-68(1968). (In German).

The reduction of olefins with tris(triphenylphosphine)rhodium(I) chloride discloses new possibilities of the specific hydration of double bonds in the steroids. The dependence of this reaction on the solvent, pressure, and reaction time was investigated on C = C double bonds of steroids of differing reactivity. $\Delta^4-\alpha-\beta$ unsaturated 3-ketosteroids were reduced to the 5α form. The isotope scattering in deuteration is strongly dependent on the solvent and the catalyst concentration. Specificity without isotope scattering can be obtained by selection of suitable conditions. The origin of the isotope scattering was discussed. (tr-auth)

33303 KINETICS OF THE FOUR BASIC THERMAL THREE-CENTRE EXCHANGE REACTIONS OF THE HYDROGEN ISOTOPES. Le Roy, D. J.; Ridley, B. A.; Quickert, K. A. (Univ. of Toronto). Discuss. Faraday Soc., No. 44, 92-107(1967).

Rate constants were determined for the reaction $D + D_2 \rightarrow D_2 + D$. These, together with earlier results for the reactions $H + H_2 \rightarrow H_2 + H$, $H + D_2 \rightarrow HD + D$, and $D + H_2 \rightarrow DH + H$, are considered in comparison with ab initio and semiempirical calculations. The experimental results for all four reactions can be treated in a satisfactory manner by a modified form of transition state theory, and suggest a barrier height of approximately 9.2 kcal mole^{-1} and a reaction path which, even for the heteronuclear complexes, is essentially coincident with the normal mode coordinate for the asymmetric vibration of the complex. On the basis of this treatment the force constants for the symmetric and asymmetric vibrations of the complex are approximately 2.6×10^5 and -0.27×10^5 dyne cm^{-1}, respectively. (auth) (UK)

33304 LUMINESCENT SPECTRA OF COMPLEX COMPOUNDS OF URANYL NITRATE WITH HETEROCYCLIC AMINES. Kopashova, I. M.; Skutov, I. K.; Umreiko, D. S. Zh. Prikl. Spektrosk., 8: 80-6(Jan. 1968). (In Russian).

Investigation of the complexes of uranyl nitrate with pyridine and its derivatives (α-picoline, benzyl pyridine) and with α,α'-dipyridyl and 1,10-phenanthroline showed that in the fluorescence spectra of these compounds the frequencies of the intramolecular oscillations were absent. This was explained by the interaction of the compound parts of the complex among themselves and by the leakage of the electron oscillation excitation energy. On the basis of the isotopic displacement of the luminescent spectral lines of uranyl cesium nitrate during its enrichment with ^{15}N, the Raman spectra of the uranyl nitrate compounds, and the calculations, by the Bedzher–Dzhons formula for the donor-acceptor bonds of the UO_2^{2+} group, the frequencies in the range from 170 to 20 cm^{-1} were related to the oscillations of the bonds of the uranyl nitrate group. Frequencies in the range from 90 to 140 cm^{-1} were interpreted as belonging to the oscillations of the uranyl–organic ligand bonds. It was found that the oscillation frequency of UO_2^{2+} and uranyl–ligand during the transition from uranyl nitrate hydrates to its complexes with heterocyclic amines vary in relation with the necessary criteria of stability of the donor-acceptor bonds of the ligands in the equatorial plane of the UO_2^{2+} group. (tr-auth)

33305 INFRARED SPECTROSCOPY STUDIES OF THE RATE OF HYDROGEN ISOTOPIC EXCHANGE BETWEEN ALCOHOL AND MERCAPTAN MOLECULES. Denisov, G. S.; Kazakova, E. M.; Ryl'tsev, E. V. Zh. Prikl. Spektrosk., 8: 690-2(Apr. 1968). (In Russian).

Data obtained on the rate of isotopic H-exchange between methyl mercaptan or isobutyl mercaptan and methanol-d in a gaseous phase, and isobutyl mercaptan-d, methanol, and acetic acid in CCl_4 showed that with the weakened H-bond the rate of H-exchange was also slowed down. The studies indicate that the rate of the H-exchange, taking place in cyclic molecular complex with H-bonds, depend primarily on the properties of the molecular-partner electron shell structures which determine the proton-donor and proton-acceptor capacity of exchanging groups during the formation of the H-bond. (R.V.J.)

33306 STUDY OF THE SURFACE TENSION OF MOLTEN MIXTURES $NaF–ZrF_4–ZrO_2$. Decroly, C.; Fontana, A.; Winand, R. (Univ. Libre, Brussels). J. Nucl. Mater., 27: 36-47(1968). (In French).

The method consists of determination of the force necessary to pull out a rectangular small platinum plate, a ridge of which is in contact with the liquid, from the surface of the liquid of the unknown surface tension. We have studied the surface tension of fused mixtures of $NaF–ZrF_4–ZrO_2$ and of $3NaF \cdot Al_2F_3$–

Al_2O_3. No marked modification of the surface tension appeared by adding ZrO_2 to $NaF-ZrF_4$ melts or Al_2O_3 to fused $3NaF \cdot Al_2F_3$. The presence of carbon dioxide in the furnace changes the surface properties of the fused mixtures $NaF-ZrF_4-ZrO_2$ and $3NaF \cdot AlF_3-Al_2O_3$. The surface tension of pure NaF is not affected by the presence of carbon dioxide. Carbon monoxide has no influence on the surface tension of the melts studied in these experiments. (auth)

33307 STUDY OF THE SOLUBILITY OF ZIRCONIUM OXIDE IN MOLTEN MIXTURES OF SODIUM FLUORIDE AND ZIRCONIUM TETRAFLUORIDE. **Decroly, C.; Fontana, A.; Winand, R. (Univ., Libre, Brussels). J. Nucl. Mater., 27: 21-35(1968). (In French).**

Successive additions of ZrO_2 to $NaF-ZrF_4$ fused mixtures showed a limit beyond which there is no more depression of the melting point. This limit corresponds to the maximum solubility of ZrO_2 in the melt at the melting point. There is an increase of the solubility of ZrO_2 when the ZrF_4 content of the mixture increases. The cryoscopic method gave a value of 2.2 for the dissociation coefficient of ZrO_2 in the $NaF-ZrF_4$ mixtures at 25 mole % ZrF_4. An excess of ZrO_2 relative to its limit of solubility was added so that ZrO_2 sediments. The salt was slowly cooled and the proportion of ZrO_2 present at saturation in the mixture and the quantity of sedimented ZrO_2 were determined. An increase of the solubility of ZrO_2 when the ZrF_4 content increases was found, but the temperature was not constant and depended on the ZrF_4 content of the bath. A sample of the ZrO_2-saturated mixture was analyzed for the quantity of ZrO_2 present when the salt was cooled slowly. The variation of the solubility versus the ZrF_4 content of the bath was thus determined at 900, 1000, and 1050°C. It was concluded that a reaction between ZrO_2 and ZrF_4 occurs, leading to the solubilization of ZrO_2 as an oxyfluoride complex. (auth)

33308 HIGH RESOLUTION STUDY OF NITRIC OXIDE NEAR 5.4 MICRONS. **Keck, D. B.; Hause, C. D. (Michigan State Univ., East Lansing). J. Mol. Spectrosc., 26: 163-74(June 1968).**

High resolution spectra of the $^2\Pi_{1/2}-{}^2\Pi_{1/2}$ and $^2\Pi_{3/2}-{}^2\Pi_{3/2}$ subbands of the fundamental and the (1−0) $^2\Pi_{3/2}-{}^2\Pi_{1/2}$ and (1−0) $^2\Pi_{1/2}-{}^2\Pi_{3/2}$ satellite bands for both $^{15}N^{16}O$ and $^{14}N^{16}O$ have been obtained and analyzed. The analysis led to the following rotational constants: For $^{15}N^{16}O$, $B_e = 1.64449 \pm 0.00008$ cm^{-1}, $D_e = (5.1 \pm 0.1) \times 10^{-6}$ cm^{-1}. For $^{14}N^{16}O$, $B_e = 1.70487 \pm 0.00006$ cm^{-1}, $D_e = (5.5 \pm 0.1) \times 10^{-6}$ cm^{-1}. The satellite data provide a method for directly determining the spin-orbit coupling constants A_0 and A_1. The A_0 and A_1 were found to be independent of isotopic substitution within the limits of accuracy of the data, indicating identical electronic structure for the two molecules considered. Values for these and other molecular parameters which could be determined are quoted. (auth)

33309 MOLECULAR CONSTANTS OF NITROGEN DIOXIDE FROM THE NEAR INFRARED SPECTRUM. **Olman, M. D.; Hause, C. D. (Michigan State Univ., East Lansing). J. Mol. Spectrosc., 26: 241-53(June 1968).**

High resolution spectra of the (1, 0, 1), (2, 0, 1), (0, 0, 3), and (1, 0, 3) bands of $^{14}NO_2$ and $^{15}NO_2$ have been obtained. An analysis of the combined ground state combination differences and reported microwave transition frequencies has led to improved values of the rotational and centrifugal distortion constants for the ground state of each molecule, including empirical P^6 terms. The (1, 0, 1) and (2, 0, 1) bands of each molecule have been analyzed giving improved values for the band origins and upper state rotational constants. From the rotational constants determined, it has been possible to calculate the rotational constants for the (0, 0, 3) and (1, 0, 3) vibrational states. A predicted spectrum calculated using these values has led to the identification of the Q-branch transitions observed in the (0, 0, 3) regions as the $^qQ_k(N)$ transitions of the (0, 0, 3) band, and not the Q-branches of a type B band as had been reported previously. Measurement of the observed spin-splittings in the (2, 0, 1) bands has led to a determination of the effective spin-rotation coupling constants for the (2, 0, 1) vibrational levels. (auth)

33310 STABILITY CONSTANTS OF CHLORO AND NITRATO COMPLEXES OF THORIUM. **Ohashi, Hiroshi; Morozumi, Takashi (Univ. of Hokkaido, Sapporo). Nippon Genshiryoku Gakkaishi, 10: 244-8(1968). (In Japanese).**

Stability constants of $ThCl^{3+}$ and $ThNO_3^{3+}$, K_{c1} and K_{c2}, were determined electrometrically by means of the pCl-stat in solutions of KNO_3, $NaClO_4$, and $NaNO_3-NaClO_4$. The results are presented as a function of concentration, ranging from 0.05 to 1.6 mole/l at temperatures of 15, 25, and 35°C. The value of K_{c1} increased markedly with decreasing concentration, especially in the range of concentration below 0.5 mole/l. For example, whereas K_{c1} was 6 and 2.8 (mole/l)$^{-1}$, respectively, at 0.5 and 1 mole/l, extrapolation to zero concentration gave a thermodynamic stability constant K_a as high as 37(mole/l)$^{-1}$. From the value of K_a and its temperature dependence, the free energy and the heat of complex formation were estimated to be −2.14 and nearly zero kcal/mole, respectively. Hence, a value of 7.2 eu was derived for the entropy of complex formation. The apparent stability constant of $ThCl^{3+}$ in a solution of KNO_3 was smaller than that in a solution of $NaClO_4$ by an amount of 15 to 50%, depending on the concentration of solution. This discrepancy was explained by assuming the formation of $ThNO_3^{3+}$. The estimated stability constant of $ThNO_3^{3+}$ varied from 4 to 0.75 (mole/l)$^{-1}$ with an increase of concentration from 0 to 1 mole/l. (auth)

33311 HYDROLYSIS OF URANYL IONS AT ELEVATED TEMPERATURES. **Ryzhenko, B. N.; Naumov, G. B.; Goglev, V. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl.), 4: 363-7(1967).**

Translated from Geohimiya, No. 4, 413-17(1967).

An analysis of various mechanisms of uranyl ion hydrolysis was carried out. It is shown that at certain uranium concentrations a change of the hydrolysis mechanism occurs and experimental data obtained for solutions at high concentration cannot be used directly in studying uranium behavior in natural waters with low concentration. The constant for the first step of uranyl ion hydrolysis was determined by the method of electrical conductivity at temperatures of 100 to 200°C. Increase of temperature shifts the change of hydrolysis mechanism toward higher uranium concentrations. (auth)

33312 COPRECIPITATION OF THORIUM WITH IRON HYDROXIDE IN AMMONIUM BICARBONATE SOLUTION. **Novikov, A. I.; Gordeeva, L. N. (Lenin Tadjik State Univ., USSR). Dokl. Akad. Nauk Tadzh. SSR, 11: 37-40(1968). (In Russian).**

The processes of oxidation, sorption, and coprecipitation of small quantities of Th (2.15×10^{-4} and 2.15×10^{-6} g-ion/l) with iron hydroxide (0.1 mg-at iron) were investigated in 1$\underline{M}$ ammonium nitrate and 0.5$\underline{M}$ ammonium bicarbonate solution over a wide pH interval. The increase of the concentration of the carbonate ions leads to an increase of the pH interval in which Th is not precipitated, a decrease of the coprecipitation of Th with iron hydroxide owing to the filling of the coordination sphere of thorium ions complexed with carbonate ions, which impedes formation of bonds between the carrier and microcomponents. Concentration of Th can be carried out by coprecipitation with iron hydroxide in nitrate−carbonate medium in the pH interval 4.5 to 6 and pH > 12 at room temperature, but better with heating to 80°C at pH 5 to 8 and pH > 12. The possibility was investigated of the separation of Th from Fe by precipitation with iron hydroxide in nitrate−carbonate medium, which can be carried out at room temperature in the pH interval from 9 to 10 and with heating the solution to 80°C at pH near 10. (tr-auth)

33313 INFLUENCE OF FLUORIDE IONS ON THE PROCESS OF ELECTROLYTIC PRECIPITATION OF URANIUM DIOXIDE FROM MOLTEN SALTS. **Smirnov, M. V.; Koryushin, A. P.; Komarov, V. E. At. Energ. (USSR), 24: 381-3(Apr. 1968). (In Russian).**

Studies were made of the anodic polarization of platinum electrode in a $NaCl-KCl$ melt with an initial content of 7 wt % UO_2Cl_2 at 1050°K and in chloride and chloride fluoride electrolyte, also, containing 7 wt % UO_2Cl_2 at 1050°K. Results showed that in the chloride-fluoride electrolytic process uranyl degradation and its reaction with uranium dioxide forming mixed oxides was inhibited considerably. It was established that during electrolysis at identical temperatures and concentrations of tetravalent uranium in the fluoride-containing melts, the content of uranium dioxide precipitating on the cathode is more nearly stoichiometric than the dioxide produced by electrolysis of pure chloride electrolytic. (R.V.J.)

33314 PRODUCTION OF THE OXYCHLORIDE OF PENTAVALENT URANIUM $UOCl_3$. **Glukhov, I. A.; Eliseev, S. S.; Vozhdaeva, E. E. (Inst. of Chemistry, Dushanbe, USSR). Zh. Neorg. Khim., 13: 919-21(Apr. 1968). (In Russian).**

The method and techniques for the production of uranium oxytrichloride, $UOCl_3$, by means of the exchange reaction $UO_3 + MoCl_5 \rightarrow UOCl_3 + MoO_2Cl_2$ were developed. Preliminary data on the properties of this oxychloride are reported. (tr-auth)

33315 HOMOMOLECULAR AND ISOTOPIC EXCHANGE OF OXYGEN ON LANTHANUM OXIDE. **Sokolovskii, V. D.; Sazonov, L. A.; Boreskov, G. K.; Moskvina, Z. V. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Kataliz, 9: 130-4(Jan.-Feb. 1968). (In Russian).**

The homomolecular exchange reaction of oxygen on lanthanum oxide was investigated in the temperature interval from −150 to +350°C. Three temperature ranges for the reaction were detected with different apparent activation energies. As in the case of gadolinium oxide, in one of the ranges a negative apparent activation energy was observed. The order of the reaction was determined for all three temperature ranges. It was established that initial heating of the catalyst in a vacuum at 700°C leads to the appearance of an increased catalytic activity, which is sufficiently stable in an oxygen atmosphere. The kinetics of the isotopic exchange of oxygen in the gaseous phase with the oxygen of the oxide was investigated in the temperature range from 210 to 350°C. It was found that under conditions of joint occurrence, homomolecular exchange and hetero exchange have close activation energies (10 and 9 kcal/mole, respectively). (tr-auth)

33316 PRODUCTION OF URANIUM DIOXIDE BY HYDROTHERMAL REDUCTION. Robins, R. G. (University Coll., Wollongong, New South Wales). Australas. Inst. Mining Met. Proc., No. 2, 193-6(1967).

From Symposium on Research in Chemical and Extraction Metallurgy, Sydney. See CONF-650225.

Uranium dioxide was precipitated by the hydrogen reduction of acid uranyl nitrate solutions. Standard free energies of formation for the products were calculated. A combined log p_{H_2} −pH diagram was constructed. (M.C.G.)

33317 TRIPLET–TRIPLET ANNIHILATION AND DELAYED FLUORESCENCE IN ISOTOPIC MIXED CRYSTALS OF BENZENE. Hatch, G. F.; Nieman, G. C. (Univ. of Rochester, N. Y.). J. Chem. Phys., 48: 4116-25(May 1, 1968).

The behavior of triplet excitations of a single isotopic guest in a benzene crystal (C_6H_6 in C_6D_6) is investigated as a function of temperature from 2 to 15°K by detailed measurements of the phosphorescence. It is found that even in dilute systems there is significant (~20% for 0.2% guest) temperature-independent annihilation below 8.0°K. Above 8.0°K a thermally activated annihilation process dominates the phosphorescence quenching in an ultrapure sample. Thus while the first-order decay rate, which includes impurity quenching, increases by less than a factor of 2, the second-order annihilation rate increases by five orders of magnitude when the temperature is raised from 4 to 12°K with an activation energy equal to the known trap depth. The difficulty of fitting a nonexponential decay to the combination of first- and second-order decays is discussed and a new method is suggested which accomplishes this. Measurements of the temperature dependence of the phosphorescence decay, the steady-state phosphorescence intensity, and the steady-state delayed fluorescence intensity provide independent evaluations of the annihilation rate which are in good agreement with one another at all temperatures. The low delayed-fluorescence quantum yield in benzene is discussed. (auth)

33318 ON ION COMPOSITION OF MELTED MIXTURES OF SODIUM, POTASSIUM, LEAD, AND URANIUM CHLORIDES. Karzhavin, S. V.; Nichkov, I. F.; Raspopin, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Ukr. Khim. Zh., 34: 412-13(1968). (In Russian).

The effects of uranium chloride additives on the emf in the chain of $NaCl-KCl-PbCl_2$ systems were studied in the reaction $2UCl_4 + Pb \rightleftharpoons UCl_2 + PbCl_2$. The curves of equilibrium lead potentials are given as a function of its ion concentrations in the electrolyte $NaCl-KCl-UCl_3-UCl_4-PbCl_2$ at temperatures 700, 750, and 800°C. The change of lead ion activity coefficient begins with the concentration of about 2 mole % $PbCl_2$ reached with the addition of 10 mole % UCl_4. The maximum content of electrolyte was considered to be 2% $PbCl_2$, 4% UCl_3, 6% UCl_4, 44% NaCl, and 44% KCl. (R.V.J.)

33319 ISOLATION OF TITANIUM(IV), ZIRCONIUM(IV), NIOBIUM(V), TANTALUM(V), TIN(IV), AND THORIUM(IV) BY PRECIPITATION WITH PHYTIN. Futamura, Eiji; Kuroki, Hiromu (Yawata Iron and Steel Co., Ltd., Japan). Bunseki Kagaku, 17: 569-74(May 1968). (In Japanese).

It has been found that phytin reacts with titanium(IV), zirconium(IV), niobium(V), tantalum(V), tin(IV), and thorium(IV) to give white precipitates from boiling acidic solutions. The reaction is more complete in a perchloric acid solution than in a hydrochloric or sulfuric acid solution, and is 100% or nearly 100% quantitative in the presence of ferrous ion. The amount of coprecipitated iron is small. This reaction can possibly be applied to the isolation of above mentioned elements in the analysis of iron and steel. (auth)

33320 ISOTOPE EFFECTS IN AUTOXIDATION. II. CONSTITUTION AND KINETIC HYDROGEN ISOTOPE EFFECT IN THE AUTOXIDATION OF THE TERTIARY CARBON ATOM. Rummel, S.; Krumbiegel, P.; Huerner, H. (Institut fuer Stabile Isotope, Leipzig). J. Prakt. Chem., 37: 206-13(Feb. 1968). (In German).

Three structurally related hydrocarbons, cumene, phenylcyclohexane, and phenylcyclopentane, and their (α-D) derivatives were synthesized in a modified Friedel–Crafts reaction. Their autoxidation was catalyzed by Co stearate. The maximum autoxidation rates gave the following mean primary kinetic isotope effects at 61°C: cumene, 61 atom % α-D: $k_H/k_D = 5.8 \pm 0.4$; phenylcyclopentane, 88 atom % α-D: $k_H/k_D = 1.3 \pm 0.05$; phenylcyclohexane, 83 atom % α-D: $k_H/k_D = 1.05 \pm 0.03$. These data are discussed for the quasihomologous series in terms of different energetic dependences in the transition state of the reaction. The data for cumene showed a slight increase of k_H/k_D on lowering the temperature (to 5.84 at 52°C) as do those for phenylcyclopentane (to 1.37 at 52°C). For phenylcyclohexane at 76.7°C the value is still 1.05; deviations are constant with temperature for these data. (BBB)

33321 INTERACTION OF THORIUM TETRABROMIDE HYDRATE WITH DIMETHYL SULFOXIDE. Ivanova, O. M.; Petrov, K. I.; Molodkin, A. K.; Saralidze, O. D.; Kozina, L. E. (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 1324-6(May 1968). (In Russian).

In the interaction of thorium tetrabromide $ThBr_4 \cdot \underline{n}H_2O$ with dimethylsulfoxide in methanol solution, the following compounds were precipitated: $ThBr_4 \cdot 4(CH_3)_2SO \cdot 4H_2O$, $ThBr_4 \cdot 6(CH_3)_2SO \cdot 3H_2O$, $ThBr_4 \cdot 8(CH_3)_2SO$, and $ThBr_4 \cdot 10(CH_3)_2SO \cdot 4 \cdot 5H_2O$. It was shown (on the basis of the ir absorption spectra) that all molecules of dimethyl sulfoxide in the compounds indicated are coordinated with thorium through the thorium–oxygen bond. (tr-auth)

33322 SYNTHESIS AND SOME PROPERTIES OF COMPLEX FORMATE COMPOUNDS OF THORIUM. Molodkin, A. K.; Ivanova, O. M.; Kozina, L. E.; Petrov, K. I. (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 1327-38(May 1968). (In Russian).

The following previously unknown formate compounds of Th were synthesized: $Rb[Th(HCOO)_5]$, $Rb_2[Th(HCOO)_6] \cdot 3H_2O$, $Rb_4[Th(HCOO)_8]$, and $Na_4[Th(HCOO)_8]$. Some properties of these compounds and of the complex states $[Th(HCOO)_4] \cdot \underline{n}H_2O$ ($\underline{n}$ = 0 and 2), $Me[Th(HCOO)_5] \cdot$ (Me = K^+ and Cs^+), $Cs_2[Th(HCOO)_6]$, $Ba[Th(HCOO)_6] \cdot \underline{n}H_2O$ ($\underline{n}$ = 0 and 2), $Cs_3[Th(HCOO)_7]$, and $Cs_4[Th \cdot (HCOO)_8]$ were investigated. The density, refractive index, molecular electroresistance, etc., were determined. The original molecular refraction and the refraction of the thorium–formate group bond showed that this bond in most formate compounds of thorium is probably close to the ion type. Thermographic and thermogravimetric methods together with infrared spectroscopy showed that all the compounds of the alkali metals and Ba during thermal decomposition formed carbonates of the metals and thorium dioxide. Stable intermediate products were not observed. Thorium dioxide was formed as a result of the decomposition of tetraformate thorate. In the thermal decomposition of all compounds, the formation of elementary carbon occurred. The thermal stability of the compounds increases in the series K < Rb < Cs (Na < Rb < Cs). (tr-auth)

33323 COMPOUNDS OF URANIUM TETRACHLORIDE WITH TRIBUTLYPHOSPHINE OXIDE. Ellert, G. V.; Bolotova, G. T.; Krasovskaya, T. I. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 1386-92(May 1968). (In Russian).

The interaction of tributylphosphine oxide with uranium tetrachloride in various media was investigated and the compounds separated were $UCl_4 \cdot \underline{n}Bu_3PO$, where $\underline{n}$ = 1.5; 2; 3.5; 4; 5; and 8, and $UCl_3OH \cdot 3Bu_3PO$. It was shown that the interaction of the components proceeds in the framework of coordination representation with formation of neutral $[UCl_4 \cdot 2(4)Bu_3PO]$ and cation complexes $[UCl_{8-\underline{m}}(Bu_3PO)_{\underline{m}}]Cl_{\underline{m}-4}$ ($\underline{m}$ is 5.8). It was shown that in the organic phase with saturation the neutral complex $UCl_4 \cdot 2Bu_3PO$ is extracted. The possibility of the formation in strongly acid media of extractable anion complexes of the type $Bu_3POH_2[UCl_6]$ was not verified. (tr-auth)

33324 CARBAMIDE-CONTAINING URANYL IODIDES. Tsapkina, I. V.; Ellert, G. V. (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 1393-7(May 1968). (In Russian).

It was shown that the presence of carbamide in alcohol and aqueous solutions of uranyl iodides significantly reduces its hydrolysis. During crystallization from such solutions the compound with the composition $[UO_25CO(NH_2)_2]I_2H_2O$ and the crystalline materials of variable composition $UO_2IOH\underline{n}CO(NH_2)_2\underline{m}I$ ($\underline{n}$ = 2.7 to 3.4 and $\underline{m}$ = 0 to 0.96) were precipitated. The removal of water from the pentacarbamide uranyl iodide leads to an abrupt variation of the color of the material from red-orange to yellow. The anhydrous $[UO_25CO(NH_2)_2]I_2$ formed during this appeared as an individual compound. The anhydrous form of the pentacarbamide uranyl iodide is very sensitive to the moisture of the air and during short-term standing water molecules are added, and the red-orange color is regained. Crystalline carbamide-containing uranyl hydroxides of the composition $UO_2(OH)_22CO(NH_2)_2$ were obtained from alcohol solutions. (tr-auth)

33325 INTERACTION OF FLUOROURANYLATES WITH OXALATE IONS. Shchelokov, R. N.; Belomestnykh, V. I. (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 1398-1403(May 1968). (In Russian).

The possibility of the step-wise replacement of fluorine in pentafluorouranylate ions by oxalate ions with formation of mixed fluorooxalate uranyl complexes of the pentacid type of the mono and dioxalate series was established on the example of potassium and guanidine derivatives. The solubility of the pentafluorouranylates of ammonium, potassium, and guanidone in aqueous solution of the corresponding oxalates was investigated. The concentration conditions for the replacement of the coordination fluorine atoms in pentafluorouranylate oxalate ions were determined. A new method for the synthesis of the fluorooxalate uranyl compounds of the pentacid type was proposed. With the replacement reaction used, the guanidine derivative of trifluoroxalate uranylate ions $(CN_3H_6)_3[UO_2(C_2O_4)F_3] \cdot H_2O$ was first obtained and the synthesis was carried out of complexes with the composition $K_3[UO_2(C_2O_4)F_3] \cdot 2H_2O$, $K_3[UO_2(C_2O_4)_2F] \cdot 3H_2O$, and $(CN_3H_6)_3[UO_2(C_2O_4)_2F] \cdot H_2O$. (tr-auth)

33326 ACID-CATALYZED HYDROLYSIS OF A SERIES OF PHOSPHORAMIDATES. Garrison, Arthur W.; Boozer, Charles E. (Southeast Water Lab., Athens, Ga. Copolymer Rubber and Chemical Corp., Baton Rouge, La.). J. Amer. Chem. Soc., 90: 3486-94 (June 19, 1968).

The acid-catalyzed hydrolysis of a series of six 2,4-dichlorophenyl methyl N-alkylphosphoramidates (I) was studied. Most of the reactions were carried out in 25% dioxane in water (v/v) in the presence of 0.19 M HCl, with the concentration of phosphoramidate being 0.002 M. The reactions were followed kinetically by ultraviolet spectrophotometry and were found to be first order in phosphoramidate. Product determination experiments showed that the hydrolysis involved P–N bond cleavage with negligible liberation of 2,4-dichlorophenol or alcohol. The product of acid hydrolysis is thus the appropriate alkylamine salt of 2,4-dichlorophenyl methyl phosphoric acid (II). Activation energies and entropies were calculated, the highly negative value of the latter showing the reaction to be bimolecular. The hydrolysis was first order in hydronium ion as shown by pH dependence studies. The phosphoramidates hydrolyzed faster by a factor of 2 in D_2O than in H_2O, indicating a fast prior protonation of the substrate. A small increase in the rate of hydrolysis of the methyl phosphoramidate was observed with increasing percentage of water in the solvent at the same pH. Linear free-energy relations were used to determine the effect of the N-alkyl substituent on the rate of hydrolysis. It was concluded that both steric and polar substituent effects operate, with an increase in bulk of the substituent hindering the reaction slightly while electron withdrawal aids the reaction. Possible mechanisms are proposed for the acid hydrolysis of the phosphoramidate diesters. (auth)

33327 UNSYMMETRICAL SECONDARY PHOSPHINE OXIDES. SYNTHETIC, ISOTOPIC EXCHANGE, AND STEREOCHEMICAL STUDIES. Emmick, Thomas L.; Letsinger, Robert L. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc., 90: 3459-65(June 19, 1968).

Two general methods are described for preparing unsymmetrical secondary phosphine oxides. One involves displacement of alkoxide from an ester of a monosubstituted phosphinic acid by a Grignard reagent; the other, reduction of an ester of a disubstituted phosphinic acid by lithium aluminum hydride. Properties of a number of new secondary phosphine oxides prepared by these methods are reported. Of special interest is benzylphenylphosphine oxide, $[\alpha]D - 0.52°C$, obtained by reduction of (–)-menthyl benzylphenylphosphinate ($[\alpha]D - 65.4°C$). This product is configurationally stable in methanol at room temperature but racemizes in methanol solutions of hydrochloric acid or sodium methoxide. In methanol-d, benzylphenylphosphine oxide rapidly exchanges the hydrogen on phosphorus for deuterium, as shown by the change in the intensity of the O–H resonance peak in the PMR spectrum. (auth)

33328 THERMODYNAMIC PROPERTIES OF UF_6. Verkhivker, G. P.; Tetel'baum, S. D.; Konyaeva, G. P. At. Energ. (USSR), 24: 158-62(Feb. 1968). (In Russian).

A brief review of the literature was made on the thermodynamic properties of UF_6. The similarity of UF_6 and CO_2 was indicated. The thermodynamic properties of UF_6 in the temperature range from 337 to 1500°K and the pressure range from 1 to 300 bar were calculated by the similarity theory method. The data obtained on the thermodynamic functions of UF_6 can be used for engineering calculations with sufficient precision for practical purposes. (tr-auth)

33329 A STUDY OF TRANSITIONS IN ^4He AND ^3He. Elwell, David Leslie. Durham, N. C., Duke Univ., 1967. 142p.

Thesis.

The molar volume and isothermal expansion coefficients of ^4He in the range 1.25 to 4.2°K and 0.5 to 28 atm were studied with particular emphasis on the region near the λ-line, and a similar study of ^3He in a region near the critical point was begun. The resonant frequency of a tunnel diode oscillator, the capacitor of which contained the helium samples, was measured. The frequency measurements determined the dielectric constant of the sample, and the Clausius–Mosotti relation was used to calculate the molar volume. The expansion coefficients were obtained from the molar volume results by graphical differentiation. A table of T_λ and V_λ at each of the pressures for which there was data is presented and it was found that $P_\lambda = 0.0499 - 64.6(T_{\lambda_0} - T_\lambda)^{1.342} + 120(T_{\lambda_0} - T_\lambda)$, where $T_{\lambda_0} = 2.173°K$. The entropy of compression along various isotherms in ^4He and the change in the compressibility along various isobars were calculated and tables are presented of these parameters for the broad regions above and below the λ-transition. High resolution expansion coefficients results near the λ-line are tabulated. Values of the specific heat at constant pressure, the pressure coefficient, and the compressibility in the neighborhood of the transition were calculated. Results along nine isobars that pass through the critical region of ^3He are presented. It was found that the peaks that occur in the expansion coefficient at pressures above the critical point are reducible by a simple scheme to a common curve. (Diss. Abstr.)

33330 IONIC SOLVATION AND GROWTH OF THORIUM DIOXIDE SOL PARTICLES. Rastogi, M. C. (Regional Inst. of Tech., Jamshedpur, India); Srivastava, O. N. Indian J. Chem., 6: 145-7(Mar. 1968).

Solvation of thorium ions was determined by the mobility method; conductivity and hydrolysis measurements were made under controlled conditions of acidity. The value of the hydration number of thorium ions was found to be 30, which seems to be of the correct order of magnitude because in the system the possibilities of the formation of hydroxy complexes, responsible for lowering the conductivity of the ion, are reduced in the presence of H^+ ions. A scheme for the growth of the ThO_2 particle into three-dimensional interwoven lattice was suggested, taking the coordination number of thorium ion to be six. (auth)

33331 CRYSTAL STRUCTURES AND LATTICE PARAMETERS OF THE COMPOUNDS OF BERKELIUM. II. BERKELIUM TRICHLORIDE. Peterson, J. R.; Cunningham, B. B. (Univ. of California, Berkeley). J. Inorg. Nucl. Chem., 30: 823-8(May 1968).

$BkCl_3$ was found to exhibit the UCl_3-type hexagonal structure. Powder data from three samples give average lattice parameters $\alpha_0 = 7.382 \pm 0.002$ Å and $c_0 = 4.127 \pm 0.003$ Å, where the error limits are the 95 percent confidence interval calculated using the standard statistical method for the average of three independent determinations. (auth) (UK)

33332 SOME COMPLEXES OF AMERICIUM AND CURIUM WITH OXINE, CUPFERRON, AND N-BENZOYLPHENYLHYDROXYLAMINE. Akatsu, Eiko; Hoshi, Michio; Ono, Reiko; Ueno, Kaoru (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 252-5(May 1968).

The complexes of Am and Eu with cupferron; Cm, Am, and Pu with oxine; and Cm, Am, Pu, U, Th, Pm, and Eu with N-benzoylphenylhydroxylamine (NBPHA) were studied. The composition of the complexes are given in molar ratio and pH corresponding to 50% extraction. A study of the effects of contact time and pH on the extractability of cupferrates and oxinates was made. The distribution ratios suggest the possibility of separating Pu from Th in acidic media using NBPHA. (D.H.M.)

33333 PHOTOPOLYMERIZATION OF HYDROXYPROPYL ACRYLATE AND TETRAETHYLENE GLYCOL DIMETHACRYLATE INITIATED BY URANYL ION. Higgins, Cecil E.; Baldwin, Willis H. (Oak Ridge National Lab., Tenn.). J. Appl. Polymer Sci., 12: 1471-5(1968).

Uranyl nitrate, acetate, sulfate, and dibutyl phosphate were used in solution for the photoinitiation of homopolymerization and copolymerization of hydroxypropyl acrylate and tetraethylene glycol dimethacrylate. Solvents used included water, water–ethylene glycol mixtures, and dimethylformamide. Polymer yields in excess of 90% can readily be obtained by exposing solutions containing $0.014\underline{M}$ UO_2^{2+} to light from a tungsten bulb for 1 hr. The rigidity of the polymers varied directly, the affinity for water inversely, with the concentration of tetraethylene glycol dimethacrylate in the monomer mixture. Poly(hydroxypropyl acrylate) contained 52% water and poly(tetraethylene glycol dimethacrylate) 34% water, at equilibrium. (auth)

33334 PRECIPITATION OF PLUTONIUM(IV) TUNGSTATE. Watanabe, Kenju (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 260-1(May 1968).

A method for the preparation of plutonium(IV) tungstate in aqueous solutions is described. A few milligrams of Pu(IV) in milliliter quantities of aqueous solution of known composition were precipitated by adding a measured volume of sodium tungstate solution. The mole ratio between tungstate and plutonium was 2.5 to 3.8 in precipitates obtained from acidic solution, whereas the ratio reduced below 2 in those from neutral solutions. Solubility studies indicated that the tungstate solubility increased with increasing pH in acidic media, whereas it decreased in neutral or basic solution. This is probably due to the formation of plutonium hydroxide. (P.C.H.)

33335 CONCURRENT ION–MOLECULE REACTIONS. PART 5. REACTIONS IN MIXTURES OF METHYL CHLORIDE WITH DEUTERIUM AND TETRADEUTEROMETHANE. Harrison, A. G. (Univ. of Toronto); Thynne, J. C. J. Contract AT(40-1)-2968. Trans. Faraday Soc., 64: 1287-95(May 1968). (ORO–2968-33).

The reactions were studied by the ratio plot method. The following reactions were detected and the cross-sections measured at 10.5 V cm^{-1} repeller field strength: $CH_3Cl^+ + CH_3Cl \rightarrow CH_4Cl^+ + CH_2Cl$; $CH_2Cl^+ + CH_3Cl \rightarrow CH_4Cl^+ + CHCl$; $CD_4^+ + CH_3Cl \rightarrow CD_4H^+ + CH_2Cl$; $CH_3Cl^+ + CD_4 \rightarrow CH_3ClD^+ + CD_3$; $CD_4^+ + CH_3Cl \rightarrow CH_3ClD^+ + CD_3$; $D_2^+ + CH_3Cl \rightarrow D_2H^+ + CH_2Cl$; and $D_2^+ + CH_3Cl \rightarrow CH_3ClD^+ + D$. Rate constants for the self-reactions in methyl chloride were measured both at 10.5 V cm^{-1} repeller field and at thermal ion energies. These results were compared with those reported for other mixtures and with the theoretical results calculated on the basis of the ion-induced dipole model. (auth) (UK)

33336 THE KINETICS OF SOME ISOTOPIC EXCHANGE REACTIONS OF ANIONIC RUTHENIUM-(II), -(III), AND -(IV) CHLORO-COMPLEXES IN CONCENTRATED AQUEOUS $H^{36}Cl$ SOLUTIONS. Adamson, M. G. (Univ. of Adelaide). J. Chem. Soc., A, No. 6, 1370-7(1968).

The kinetics of the apparent isotopic exchange reaction $RuCl_6^{3-} + {}^{36}Cl^- \rightleftharpoons RuCl_5{}^{36}Cl^{3-} + Cl^-$ were studied and rate parameters obtained. Increase of the total hydrochloric acid concentration from 6.0 to 11.75 $\underline{M}$ caused a decrease in the rate of exchange which, in this acid concentration range, was considerably less than the known rate of aquation of $RuCl_6^{3-}$ in more dilute acid. The activation enthalpy of the exchange in both 6.0 and 11.3$\underline{M}$ hydrochloric acid was ca. 25 kcal. $mole^{-1}$, which indicates that the overall exchange of chloride ions is controlled by the aquation of $RuCl_6^{3-}$. The low exchange rates are correlated with the considerable reduction in water activity at high acid concentrations, and this is taken as evidence for the operation of a genuine S_N2 type mechanism in the acid hydrolysis of $RuCl_6^{3-}$. The effect of producing small amounts of lower oxidation states of ruthenium in $RuCl_6^{3-}$ – ${}^{36}Cl^-$ exchange solutions was investigated. The results indicated that, whereas ruthenium(II) does not cause noticeable catalysis, ruthenium(I) may be extremely active. Irradiations with 2537 and 3660 Å light showed that the $RuCl_6^{3-}$ – ${}^{36}Cl^-$ exchange system is not strongly photosensitized by these wavelengths. The small acceleration observed with 3660 Å light may arise from photoaquation of $RuCl_6^{3-}$. Isotopic chloride ion exchange experiments were carried out on 0.025$\underline{M}$-ruthenium(II) and mononuclear ruthenium(IV) solutions in ca. 11$\underline{M}$ hydrochloric acid at 25°C. Infinite-time activity distributions indicated that the principal chlororuthenium species undergoing exchange in these solutions were $RuCl_4^{2-}$, for ruthenium(II), and a $RuCl_6^{2-}$ – $RuOHCl_5^{2-}$ equilibrium mixture, for ruthenium(IV). The rates of exchange revealed that the order of ligand lability in the higher (anionic) chlorocomplexes of ruthenium is Ru(II) > Ru(III) > Ru(IV). The most important factors which contribute to the variation in rates of solvolytic aquation of Group VIII transition-metal hexachlorocomplexes; the occurrence of depressed rates of aquation at high acid concentrations; and direct chloride–chloride substitution paths in metal chloro-complexes, are also discussed. (auth) (UK)

33337 THERMODYNAMIC ISOTOPE EFFECT OF LITHIUM, CARBON, NITROGEN, CHLORINE, COPPER, AND URANIUM COMPOUNDS. Kakihana, Hidetake; Yato, Yumio; Amaya, Toshihiko (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 5: 236-45(May 1968).

The G and F matrix method was applied to theoretical calculation of the frequency shifts of linear molecules XY_2 and XYZ, as well as of octahedral molecules XY_6. Using these values, reduced partition function ratios of lithium, carbon, copper, nitrogen, chlorine, and uranium compounds were calculated. (auth)

33338 STRUCTURE OF THE EIGHT CO-ORDINATE COMPLEX TETRAMETHYLAMMONIUM URANYL TRIS-DIETHYLDITHIOCARBAMATE. Bowman, K.; Dori, Z. (Temple Univ., Philadelphia). Chem. Commun., No. 11, 636(1968).

Information concerning the bonding between the heavy elements and sulphur donor atoms is very limited, and no structural information has been available. The crystal and molecular structure of $[Me_4N][UO_2 \cdot 3DTC]$ is reported. (UK)

33339 STUDY OF THE SYSTEM ZIRCONIA–CERIUM OXIDE AT HIGH TEMPERATURE. Rouanet, Alain (Centre National de la Recherche Scientifique, Montlouis, France). Compt. Rend., Ser. C, 266: 908-11(Mar. 18, 1968). (In French).

The study of the zirconia–cerium oxide system at high temperatures showed a strong dissociation of the cerium oxide for average contents of zirconium oxide. Cerium oxide strongly diluted in zirconia was only very slightly dissociated. The formation of a pyrochlore phase was examined. The liquidus curve for various mole concentrations is given. The parameters of the cubic cell of the solid solutions were found as a function of their composition. Under the influence of zirconia and in proportion to content, there is either a strong dissociation of the cerium oxide or the maintenance of a high oxidation state with predominance of Ce^{4+}. (J.S.R.)

33340 SELF-EXCHANGE REACTION OF DEUTERIUM IN MONODEUTERIOTOLUENE CATALYZED BY NICKEL AND PLATINUM. Hirota, Kozo (Inst. of Physical and Chemical Research, Tokyo); Ueda, Tomiko; Kitayama, Toyoki; Itoh, Michiya. J. Phys. Chem., 72: 1976-82(June 1968).

The self-exchange reaction of deuterium in monodeuteriotoluene catalyzed by nickel or platinum has been investigated in its three kinds of species deuterated at the ortho, meta, or para position under the condition that the effect of hydrogen occluded in the metal can be neglected. From the result, formation of the dissociative intermediate not only of the tolyl type but also of the benzoyl type has been estimated from the deuterium transfer from the ring positions to the methyl position as well as mutual deuterium transfer among the ring positions. The dissociative intermediates, especially of the tolyl type, have been deduced not to arrange parallel to the surface from the order of the transfer rate of ring hydrogens (para > meta ≫ ortho). Roles of the dissociative intermediates on metals are discussed in the hydrogenation as well as in the exchange reactions of alkylbenzene with deuterium or deuterium oxide. (auth)

33341 SOME TENSIMETRIC STUDIES IN THE MIXED CERIA–TERBIA SYSTEM. Kordis, J.; Eyring, L. (Arizona State Univ., Tempe). J. Phys. Chem., 72: 2030-44(June 1968).

The ceria–terbia ternary system has been studied at 10% composition intervals by both isobaric and isothermal tensimetric techniques in the oxygen pressure range 0 to 1 atm and the temperature range 450 to 1100°. In addition, x-ray diffraction and pycnometric studies on selected powder specimens were made to elucidate the more interesting features of the system. The thoria–terbia system was also sketched by isobaric measurements. The tensimetric measurements indicated that there was no appreciable valency stabilization of the component oxides by each other. The more sensitive tensimetric measurements reflected complex changes in the solids which were not revealed by x-ray studies. Although most of the compositions were single phase over the entire range of oxygen content, they were far from ideal solutions but rather showed incipiently many features common to the terbia and praseodymia studies which had previously been made. Hysteresis and pseudophase formation occurred in this system analogously with the TbO_x–O_2 and PrO_x–O_2 systems. However, these features as well as the formation of intermediate phases were smeared out as the ceria content increased. (auth)

33342 HEATS OF IMMERSION IN THE THORIUM OXIDE–WATER SYSTEM. IV. VARIATION OF THE NET DIFFERENTIAL HEAT OF ADSORPTION WITH SPECIFIC SURFACE AREA. Holmes, H. F.; Fuller, E. L. Jr.; Secoy, C. H. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Phys. Chem., 72: 2095-2100(June 1968). (ORNL-P-3507).

Net differential heats of adsorption of water on thorium oxide were obtained from the integral heats of immersion of samples containing known amounts of presorbed water. The samples were prepared by the thermal decomposition of thorium oxalate and were carefully characterized as to purity, calcining temperature, particle size, and crystallite size. Specific surface areas ranged from 3 to 14 m^2/g. Initial net differential heats of adsorption at low surface coverages ranged from −15 to −40 kcal/mole. Results were interpreted in terms of dissociative chemisorption to form surface hydroxyl groups with additional contributions from hydrogen bonding involving surface hydroxyl groups and irreversibly adsorbed water molecules. Samples of high specific surface area gave results typical of heterogeneous surfaces. In contrast, the sample of lowest specific surface area exhibited three regions in which the net differential heat of adsorption was independent of surface coverage. The results show that high calcination temperatures are required to produce a relatively low specific surface area material that is indicative of an ideal planar surface. (auth)

33343 MESOMORPHIC PHASES. II. PROTON AND DEUTERIUM MAGNETIC RESONANCE STUDIES OF THE DIMETHYLDODECYLAMINE OXIDE–DEUTERIUM OXIDE SYSTEM. Lawson, K. D.; Flautt, T. J. (Procter and Gamble Co., Cincinnati). J. Phys. Chem., 72: 2066-74(June 1968).

Proton and deuterium nmr studies have been made on the dimethyldodecylamine oxide–deuterium oxide system. The fluid and viscous isotropic phases produce high-resolution proton spectra from the surfactant protons. The deuterium from the D_2O yields spectra in which the quadrupole coupling is averaged to zero. The neat and middle mesophases produce "powder-type" deuterium spectra and "super-Lorentzian" proton lines 125–150 mG in width. The proton line shape is attributed to a distribution of correlation times in the hydrocarbon chains. The small quadrupole coupling (0.5–3.0 kHz) in these phases indicates a relatively high average mobility of the D_2O. Both H^1 and H^2 data support the concept of two kinds of water — self-associated and surfactant-associated. The high-resolution proton spectra and the averaged deuterium spectra of the viscous isotropic phase are attributed to the fact that the structure is cubic, allowing the structural units to possess isotropic rotational motion. A line width parameter, $R(5/2)$, is used to establish differences between proton lines from the neat and middle phases and to observe the effects of temperature on the line shapes. Phase transitions determined by nmr line widths and second moments occur at lower temperatures than those determined optically. Regions are found in the phase diagram in which two phases coexist. In these regions the exchange of D_2O between the two phases is very slow. The nmr data are consistent with the proposed structures of the lyotropic mesophases but do not unambiguously define the structures. The nmr parameters of the mesomorphic phases in this system are similar to those observed in the same kind of phases in other surfactant-water systems. (auth)

33344 MESOMORPHIC PHASES. I. X-RAY STUDIES OF THE DIMETHYLDODECYLAMINE OXIDE–DEUTERIUM OXIDE SYSTEM. Lawson, K. D.; Mabis, A. J.; Flautt, T. J. (Procter and Gamble Co., Cincinnati). J. Phys. Chem., 72: 2058-65 (June 1968).

A detailed x-ray study has been made of the lyotropic mesomorphic phases found in the dimethyldodecylamine oxide–deuterium oxide system. Discontinuities were found in the x-ray long spacings at phase boundaries approached by changing either the concentration of surfactant or the temperature. The positions of the phase boundaries agree well with previously published phase diagrams of this system. The data indicate two phase regions near the boundaries, proving that the phase transitions are first order. The data have been examined to test the various structures proposed for the mesophases. Although the data can be explained using a cylindrical model for the middle phase, the face-centered-cubic structure for the viscous isotropic phase, and a lamellar structure for the neat phase as has been proposed for other mesomorphic systems, in this system it appears, in addition, that the structural units are composed of surfactant and associated water. (auth)

33345 MISCIBILITY OF LIQUID METALS WITH SALTS. VIII. STRONTIUM–STRONTIUM HALIDE AND BARIUM–BARIUM HALIDE SYSTEMS. Dworkin, A. S.; Bronstein, H. R.; Bredig, M. A. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Phys. Chem., 72: 1892-6(June 1968). (ORNL-P-3615).

Phase diagrams of the alkaline earth metal–metal halide systems $Sr-SrCl_2$, $Sr-SrBr_2$, $Sr-SrI_2$, $Ba-BaBr_2$, and $Ba-BaI_2$ were determined. Salt–metal miscibility was much greater than in the calcium systems and increased with the size of either the metal or halide ion. The critical solution (consolute) temperatures for the five systems above were 1106, 1064, 1056, 960, 914°, respectively, with the critical composition of approximately 52, 62, 66, 65, and 75 mole % metal, respectively. Most of the experimental results reported by Emons, et al., and their assumption of polymeric metal ions M_n^{2+} (n > 2) were found to be in error. Rather an equilibrium $M_2^{2+} \rightleftharpoons 2M^{2+} + 2e^-$ is indicated as proposed earlier in connection with electrical conductance measurements. (auth)

33346 HYDROGEN–DEUTERIUM EXCHANGE OF PROPANE ON A FUEL-CELL ELECTRODE. Barger, H. J. Jr.; Coleman, A. J. (Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.). J. Phys. Chem., 72: 2285-6(June 1968).

Isotopic exchange experiments were made on propane on a fuel-cell electrode in order to gain some insight into bond making and breaking on the catalyst surface. At all potentials used, the desorption products, methane, ethane, and propane, were found to be either completely deuterated or to contain only one hydrogen. The results indicated that exchange occurs much faster than later steps in the reaction, or, in other words, that C–H, C–D, and C–catalyst bonds are made and broken much faster than some other process closer to CO_2 on the reaction path. (P.C.H.)

33347 SPECTROPHOTOMETRIC DETERMINATION OF THE PARTICLE SIZE OF RADIOACTIVE COLLOIDAL GOLD. Caro, Ricardo A.; Ingrand, Jacques (Centre d'Etudes Nucleaires, Saclay, France). Rev. Opt., 44: 281-93(June 1965). (In French).

Radiogold (^{198}Au) in colloidal form is used in radiodiagnostic and radiotherapeutic techniques, and it is frequently necessary to ascertain the size distribution of the colloidal ^{198}Au particles. The determination of the particle size of radiogold colloid was undertaken by a simple spectrophotometric method. After measuring the optical densities (od) at 526 mμ and at 492 mμ of a 1% dilution of the colloid, the diameter of the particles can be deduced from the relation od at 526 mμ/od at 492 mμ with a theoretical calibration curve. A satisfactory correlation between the spectrophotometric and the electron microscope results was found. The field of application and the limitations of the method are discussed. (BBB)

33348 CONCENTRATION OF URANYL IONS BY AN ION EXCHANGE MEMBRANE PROCESS. Davis, Thomas Arthur. Columbia, S. C., Univ. of South Carolina, 1967. 97p.
Thesis.

The counter-diffusion of uranyl and hydrogen ions through the AMF C-103 cation exchange membrane was investigated in order to develop a continuous process for concentrating uranyl nitrate. In the proposed two-stage process, uranyl ions are transferred from a feed solution with an initial concentration of 0.01 molar to a product concentration of 0.25 molar uranyl nitrate. The driving force for this Donnan dialysis process is the Donnan potential induced by the excess of hydrogen ions in the nitric acid stripping solution. The uranyl ion flux is proportional to the uranyl nitrate concentration on the feed side of the membrane. The membrane acts as a barrier to the passage of anions and solvent but allows free passage of cations. Since the membrane is not perfectly semipermeable, osmosis and anion leakage which increase with increased stripper concentration tend to limit the effectiveness of the process. By using a more dilute stripper solution and concentrating the uranyl ions in two stages, the adverse effects of anion leakage and osmosis can be reduced, allowing higher concentrations of the product to be achieved. (Disser. Abstr.)

33349 HIGH RESOLUTION ABSORPTION, ZEEMAN, AND MAGNETIC ROTATION SPECTRA OF NITROGEN DIOXIDE IN THE NEAR INFRARED. Olman, Melvin Dennis. East Lansing, Mich., Michigan State Univ., 1967. 158p.
Thesis.

The absorption, Zeeman, and magnetic rotation spectra of the (1,0,1) and (2,0,1) vibration-rotation bands of nitrogen dioxide were obtained using Michigan State University's high-resolution (~0.03 cm^{-1} at 4200 cm^{-1}), near-infrared spectrometer. Improved values of the ground-state molecular constants of $^{14}NO_2$ and $^{15}NO_2$ were obtained from an analysis of combined ground-state combination differences and microwave transition frequencies. Accurate upper state rotational and centrifugal distortion constants and band origins were obtained for the (1,0,1) and (2,0,1) bands of $^{14}NO_2$ and $^{15}NO_2$. In addition, the change in the effective spin-rotation coupling constant between the ground and the (2,0,1) vibrational states was determined for each isotopic species. Theoretical expressions were found, which give the frequencies and transition probabilities for the Zeeman components of absorption transitions at all magnetic fields. The spectra predicted by these expressions match very closely the details of the experimental spectra at all magnetic fields available. In the magnetic rotation spectra the strongest signals come from Q-branch transitions. In the P branches there are one or more series of weaker signals that arise from transitions for which $K_{-1} = 5$, 6, and 7. The relative strengths of the Q- and P-branch signals and the dependence of the Q-branch signals on the magnetic field strength were qualitatively explained on the basis of the theoretical Zeeman patterns. (Disser. Abstr.)

33350 A NON-STOICHIOMETRIC LANTHANUM OXIDE La_2O_{3-x}. Mueller-Buschbaum, H. (Justus Liebig Univ., Giessen, Ger.). J. Inorg. Nucl. Chem., 30: 895(May 1968). (In German).

Dark-colored substances formed in high-temperature treatment of lanthanum oxide were found to consist of $LaO_{1.5-x}$, with x too small to give a distinctive x-ray pattern. (UK)

33351 EQUILIBRIUM POTENTIALS OF MOLYBDENUM IN $CaCl_2-CaMoO_4$ MELTS. Khlebnikov, B. I.; Nadol'skii, A. P. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 78-83(1968). (In Russian).

The equilibrium potential of Mo in $CaCl_2-CaMoO_4$ melts at 800 to 1150° and containing 1 to 20 wt % $CaMoO_4$ in the melts was measured. It was established that in the concentration interval studied, the Nernst equation $E = E^0 + (2.3RT/nF)\ lg[Mo^{6+}]$ was valid for the equilibrium potential of Mo. The decomposition potential was calculated for $CaMoO_4$ from thermodynamic data, the size of which is −0.89 v. The character of the isotherm of the Mo equilibrium potential, the comparison of the decomposition potentials, obtained from the thermodynamic data and calculated by the Nernst equation from experimental data, and the phase diagram indicated that the melt $CaCl_2-CaMoO_4$ is close to ideal in its properties. (tr-auth)

33352 REDUCTION OF $\gamma-UO_3$ BY HYDROGEN, CARBON MONOXIDE, AND THEIR MIXTURES. Vlasov, V. G.; Chazov, I. V.; Evseev, V. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 93-7(1968). (In Russian).

The reduction of $\gamma-UO_3$ by hydrogen, carbon monoxide, and their mixtures was studied. It was found that at 450° the reduction by CO proceeds significantly faster than with hydrogen. At 760° a reverse relation was observed between the velocity of these processes. Experimental data are explained by the adsorption-catalytic theory of reduction. In mixtures the CO and H_2 participated in the reduction non-additively. A small addition of CO to H_2 sharply increased the reducing activity of H_2 at 450°. (tr-auth)

33353 PRODUCING RARE EARTH ELEMENT CONCENTRATES FROM CHLORIDE MELTS. Drobot, D. V.; Korshunov, B. G.; Galchenko, I. E.; Durinina, L. V. (Moscow Inst. of Fine Chemical Tech.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 104-8(1968). (In Russian).

The conditions for the production of rare earth oxychlorides by interaction of fused chlorides with oxygen were investigated. Data on the equilibrium reaction $RCl_{3(liq)} + \frac{1}{2} O_{2(gas)} \rightleftharpoons ROCl_{(s)} + Cl_{2(g)}$ for La and Pr was represented by the equation lg $K_p = f(1/T)$. The phase diagrams of LaOCl−KCl and PrOCl−KCl were studied. It was found that the oxychloride ROCl is almost insoluble in the KCl melt. Tests were made on the separation of rare earths from chloride melts by means of their transfer in the oxychloride by bubbling air through the melt. (tr-auth)

33354 POROUS ORGANOPHOSPHORUS CATION EXCHANGERS. CORRELATION BETWEEN THE SORPTION PROPERTIES AND THE DENSITY OF CATION EXCHANGERS. Gribanova, I. N.; Kholkina, I. D.; Nikolaev, A. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR, 179: 1336-9 (Apr. 21, 1968). (In Russian).

Experiments were carried out to determine the quantitative correlation between the sorption properties and physical parameters of organophosphorus cationites. In view of their importance, the static volume capacity (SVC) of the phosphonic cation exchangers with respect to the Na^+ and UO_2^{2+} ions were correlated to their density under various forms, using the method described by A. I. Bulikh et al. The sorption studies were carried out in 0.1 $\underline{N}$ aqueous solutions of sodium hydroxide and 0.025 $\underline{M}$ aqueous solutions of uranyl nitrate and sulfate. The sorption capacity data of the various cation exchangers with varying degrees of porosity and phosphorylation and density variations of the salts were handled by the least squares method. A linear correlation was found to exist between the SVC with respect to the Na^+ and UO_2^{2+} ions and between the density. This makes it possible to calculate the sorption of uranium from sodium ion data and to determine the sorption capacity from an independent physical parameter, such as density. (TTT)

33355 ESR INVESTIGATIONS ON NAPHTHALENE-d_8: NAPHTHALENE-h_8-MIXED CRYSTALS IN THEIR TRIPLET STATE. Schwoerer, M.; Wolf, H. C. (Technische Hochschule, Stuttgart). Mol. Cryst., 3: 177-213(Nov. 1967).

Mixed crystals of perdeuterated naphthalene (N-d_8) and normal naphthalene (N-h_8) were investigated by ESR absorption during uv irradiation at 4.2°K. Besides the well-known ESR-lines of the isolated N-h_8 molecules in their lowest triplet state, new ESR lines were observed in this isotopically dilute system. These are named M-lines. They are due to pairs of N-h_8 molecules as nearest neighbors. Exchange interaction causes the triplet excitation to oscillate quickly between the 2 molecules. The triplet exchange energy of 2 nearest neighbor N-h_8 molecules within the unit cell was found from the line width of the M-lines to be $J/hc = (5 \pm 0.7)\ cm^{-1}$. Furthermore ESR lines of N-h_8 trimers in the triplet state were observed. Preliminary results are reported concerning the concentration dependence of the relaxation and of the lifetime of the metastable triplet state. (BBB)

33356 VIBRATIONAL RELAXATION IN CO_2/D_2O MIXTURES. Shields, F. Douglas; Burks, James Alton (Univ. of Mississippi, University). J. Accoust. Soc. Amer., 43: 510-15(Mar. 1968).

Water vapor shortens drastically the vibrational relaxation time of CO_2, and the effect has a temperature dependence that is inverse to that usually observed. These 2 effects were explained as due to chemical affinity between the CO_2 and H_2O. Measurements were made on mixtures of CO_2 and D_2O to test this chemical-affinity explanation. If chemical affinity is responsible for high efficiency and inverse-temperature effect of H_2O in deexciting CO_2 vibrations, D_2O should have a similar effect and a similar temperature dependence. Sound absorption and velocity measurements were made in CO_2/D_2O mixtures at 300, 400, and 500°K. The results showed that D_2O is from $\frac{1}{3}$ to $\frac{1}{5}$ as efficient as H_2O in de-exciting the bending-mode vibration of CO_2 in a molecular collision. The collision efficiency of D_2O for de-exciting CO_2 decreases with temperature at an even greater rate than does that of H_2O. The large difference between D_2O and H_2O invalidates the chemical affinity explanation of effect of H_2O on CO_2. An approximate semiclassical calculation of the transition probability indicates that it is possible to attribute the relaxation to an interchange between the vibration of the CO_2 and the rotation of the H_2O or D_2O. (BBB)

33357 ISOTOPIC LIGAND-EXCHANGE STUDIES ON $[Re(AMINE_4)O_2]^+$-TYPE IONS. Beard, John H.; Calhoun, Carol; Casey, Judith; Murmann, R. Kent (Univ. of Missouri, Columbia). J. Amer. Chem. Soc., 90: 3389-94(June 19, 1968).

The rates of isotopic exchange of $[Re(amine)_4O_2]^+$ with amine are reported for amine = $\frac{1}{2}$(en), CH_3NH_2, and pyridine. With en and CH_3NH_2 the exchange follows the rate law $R = k[complex] + k_1[complex][OH^-]$. At 25°C and $\mu = 0.10$, the values are $k = 8.5 \times 10^{-7}\ sec^{-1}$ and $k_1 = 6.9 \times 10^{-2}\ M^{-1}\ sec^{-1}$ (en), and $k = 9.4 \times 10^{-6}\ sec^{-1}$ and $k_1 = 4.33 \times 10^2\ M^{-1}\ sec^{-1}$ (CH_3NH_2). With pyridine the rate R is independent of $[OH^-]$ and of [py] and, at 25° and $\mu = 0.10$, $R = k[complex]$, where $k = 4.17 \times 10^{-5}\ sec^{-1}$. The rate of deuterium exchange on the amine hydrogens is extremely rapid. Exchange measurements were made on the $CN^- - [Re(CN)_4O_2]^{3-}$ and $Cl^- - [ReCl_4O(OH_2)]^-$ systems. Both reactions are complete in less than 1 min under the conditions employed. A mechanism is postulated which includes two paths of exchange: (a) dissociation assisted by solvent and (b) amide formation followed by trans dissociation. Preliminary results are reported for the oxygen isotopic exchange $[Re(X)_4O_2]^n + H_2O$, where X = $\frac{1}{2}$(en), CN^-, and py. (auth)

33358 CONTRIBUTION TO THE STUDY OF THE BINARY SYSTEM $Ag_2O-Ta_2O_5$. Brusset, Henry; Martin, Jacques Jean Pierre; Ianson, Galina (Ecole Normale Superieure, Lhomond, France. Faculte des Sciences, Paris). Bull. Soc. Chim. Fr., No. 4, 1323-8(Apr. 1968). (In French).

A thermogravimetric study and an x-ray crystallographic analysis, carried out on the binary system $Ag_2O-Ta_2O_5$, permits the determination of the optimum conditions for the synthesis of silver metatantalate from Ag_2SO_4 and Ta_2O_5 and reveals the occurrence of two other tantalates, Ag_2O, 4 Ta_2O_5 and Ag_2O, 2 Ta_2O_5, not previously reported. For the compounds Ag_2O, Ta_2O_5, and Ag_2O, 2 Ta_2O_5 the reaction constant (K) and the heat of activation (Q) were calculated. (auth)

33359 PRECIPITATION FROM HOMOGENEOUS SOLUTION. I. ZIRCONIUM AND THORIUM CUPFERRATES. II. NICKEL AND PALLADIUM SALICYLALDOXIMATES. De, Anil K.; Sahu, Chittaranjan. (Jadavpur Univ., Calcutta). Separ. Sci., 2: 11-23(1967).

Pure Zr cupferrate is quantitatively precipitated at 0 to 5° from H_2SO_4 (7 to 10% v/v) medium by cupferron prepared in situ from phenylhydroxylamine and $NaNO_2$; the precipitate, after washing with H_2O and drying at 100°, is weighed as $Zr(C_6H_5N_2O_2)_4$. Thorium cupferrate is precipitated similarly at pH 1 to 3, but the precipitate must be ignited for weighing as ThO_2. Pure and easily collected forms of Ni and Pd salicylaldoximates are precipitated at pH 9 to 10.5 and from H_2SO_4 (2 to 2.5% v/v), respectively, at room temperature by salicylaldoxime prepared in situ from salicyladehyde and hydroxylammonium chloride. When washed with 30% alcohol and dried, the precipitate is weighed as $Ni(C_7H_6O_2N)_2$ or the Pd analogue. The possibility of masking various interfering ions is considered. (Anal. Abstr., Vol 15, April 1968)

33360 COMPLEXES OF YTTRIUM AND RARE EARTHS WITH PYRIDINE-N-OXIDE. Pneumaticakis, G. A. (Athens Univ.). Chem. Ind. (London), No. 24, 770(June 15, 1968).

It was found that rare earth nitrates in alcoholic solution undergo reactions with pyridine-N-oxide to form complex cations of the type $Ln(OPy)_4(NO_3)^{2+}$, which can be precipitated as nitrates from very concentrated solutions, or as perchlorates, or tetraphenylborates from dilute solutions. Some characteristic properties of the tetraphenylborates ($X(BPh_4)_2$) are tabulated. These compounds are soluble in organic solvents and crystallise unchanged from ethanol or acetone, but are decomposed by water. They show moderately high thermal stability and melt without decomposition. Conductivity studies confirmed the formulation as 2/1 electrolytes. Some details are given on the ir spectra. The coordination number of six was tentatively assigned for these complexes. (UK)

33361 CATALYSIS OF CARBON MONOXIDE ISOTOPE EXCHANGE REACTION BY MOLYBDENUM. Gasser, R. P. H.; Marsay, C. J. (Oxford Univ.). Trans. Faraday Soc., 64: 516-21(Feb. 1968).

The initial sticking probability of carbon monoxide on a molybdenum filament is 0.3, and is essentially independent of filament temperature between 296 and 820°K. When the filament saturated with carbon monoxide is heated, the adsorbed gas is evolved in two separate bursts, which start at filament temperatures of about 450 and 850°K. Above a temperature of approximately 1100°K the filament catalyzes the carbon monoxide isotope equilibration reaction $^{12}C^{18}O + ^{13}C^{16}O = ^{12}C^{16}O + ^{13}C^{18}O$ with an efficiency of approximately 50%. The reaction first becomes measurable at the same temperature as that at which desorption of the more strongly bonded carbon monoxide occurs. (auth) (UK)

33362 KINETICS OF THE DISSOLUTION OF URANIUM DIOXIDE IN NITRIC ACID. I. Shabbir, Muhammed; Robins, R. G. (Univ. of New South Wales, Kennington). J. Appl. Chem. (London), 18: 129-34(May 1968).

The kinetics of the dissolution of uranium dioxide in nitric acid were investigated over a range of acid concentration from 0.3 to 37.0 molal. A change in the reduction mechanism for nitric acid was indicated at about 16 molal concentration. A proposed mechanism for the initial rate period of dissolution is consistent with experimental results and with the known thermodynamics of the system. (auth) (UK)

33363 PERMSELECTIVITY OF THE CHLORO COMPLEXES OF URANIUM(IV) AND URANIUM(VI) THROUGH ION-EXCHANGE MEMBRANES. Kakihana, Hidetake; Maeda, Masunobu (Tokyo Inst. of Tech.). Denki Kagaku, 35: 564-9(Aug. 1967). (In Japanese).

A study was made on the ion exchange dialysis of chloro-complexes of UO_2^{2+} and U^{4+}. In the uranium–hydrochloric acid solution, up to about 1 M hydrochloric acid concentration a considerable portion of the UO_2^{2+} exists as the cation of chloro-complex, but beyond 1 M the amount of anion tends to increase. The U^{4+}, on the other hand, mostly exists as the cation of chloro-complex up to about 4 M, and beyond this value the anion is slightly produced. In the uranium–lithium chloride–hydrochloric acid solution, the smaller values of the diffusion and selectivity coefficients of the lithium ion than those of the hydrogen ion contribute considerably to the permselectivity of uranium chloro-complex ions through cation exchange membranes. For the anion exchange membranes, on the other hand, the change in the proportion of lithium ion influences somewhat the amount of the anion of UO_2^{2+} chloro complex through the membranes. It was concluded that the selectivity coefficients of ions for the membranes, the diffusion coefficients in the membranes, the activities of ions in the solutions, etc., sensitively influence their permselectivities. (NSA of Japan)

33364 THE THERMAL DECOMPOSITION OF URANIUM(IV) AND OF URANYL(VI) FORMATES. Buttress, G. D.; Hughes, M. A. (Bradford Univ., Eng.). J. Chem. Soc., A, No. 6, 1272-7 (1968).

Initial experiments involving thermogravimetry and differential thermal analysis established the stages in the decomposition of uranyl(VI) formate monohydrate and anhydrous uranium(IV) formate in either inert or oxidizing atmospheres. Analysis of the gases evolved when anhydrous uranyl(VI) formate was heated in a vacuum at 280° indicated that the reaction is mainly represented by the equation: $3UO_2(HCO_2)_2 \rightarrow 2HCO_2H + 4CO + H_2O + 3\alpha - UO_3$. A secondary reaction occurred to a small extent, where a basic formate, $[UO(OH)(HCO_2)]$, was formed which subsequently decomposed to give a form of uranium trioxide. Studies on uranium(IV) formate at 280° indicated that in vacuum the reaction is: $2U(HCO_2)_4 \rightarrow 3HCO_2H + 4CO + H_2 + CO_2 + 2UO_2$. In air the salt is subject to oxidation and the first stage is that where uranyl(VI) formate is produced. The dehydration of the uranyl(VI) formate monohydrate followed contracting-sphere kinetics with energy of activation 36.2 ± 1.0 kcal/mole. The decarboxylation of the uranyl(VI) formate followed a Prout–Tompkins equation with energy of activation 40.4 ± 1.0 kcal/mole. In the case of uranium(IV) formate, the reaction in inert conditions followed a linear law with an energy of activation 28.5 ± 1.0 kcal/mole. Mechanisms which may account for the behavior are discussed. (auth) (UK)

33365 PROCESS FOR THE PRODUCTION OF HYDRIDES OF Ti, Zr, AND Th. Kloepfer, Harry; Knorre, Helmut; Stephan, Karl (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler). U. S. Patent 3,383,184. May 14, 1968. Priority date Aug. 26, 1964, Germany.

A process was developed for the production of hydrides of Ti, Zr, and Th by reduction of their oxides. The oxides are reacted at 350 to 750°C with a mixture of 10 to 25% alkaline earth hydride or halide and alkali metal halide. The reaction product is heat-treated for about 1 to 2 hours at 800 to 900°C. The hydrides are obtained in yields of over 90%. Their particle size is very small and can be varied by appropriate selection of grain size of the starting mixture. (M.C.G.)

33366 STUDIES ON $A_2BB'O_6$ TYPE COMPOUNDS OF ACTINIDES: PLUTONIUM COMPOUNDS. Awasthi, S. K.; Chackruburtty, D. M.; Tondon, V. K. (Bhabha Atomic Research Centre, Trombay, India). J. Inorg. Nucl. Chem., 30: 819-21(May 1968).

Compounds of the type A_2BPuO_6 with plutonium in different oxidation states are reported. They are cubic and isostructural with corresponding uranium compounds, but the ordering of the B and B′ atoms in the lattice is not as conspicuous. Diffraction data on Ba_2InPuO_6 are given and the results are discussed. (auth) (UK)

33367 THE EXCHANGE OF ISOTOPICALLY ENRICHED OXYGEN WITH $^{238}PuO_2$. Plymale, D. L. (Monsanto Research Corp., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 30: 886-90 (May 1968). (MLM-1427J).

The neutrons emitted from ^{238}Pu metal containing no light element impurities are produced by spontaneous fission at the approximate rate of 2.5×10^3n/sec/g, but the neutron generation rate from $^{238}PuO_2$ is much higher than the spontaneous fission value, and is due principally to the (α,n) reaction of ^{17}O and ^{18}O, with little or no yield from ^{16}O. Normal $^{238}PuO_2$ contains 0.037% ^{17}O and 0.204% ^{18}O, with a neutron emission of a 1.9×10^4 n/sec./g. These findings were used in a study of oxygen exchange between $^{238}PuO_2$ and gaseous oxygen of various isotopic enrichments. Oxygen exchange with $^{238}PuO_2$ was found to proceed by a first-order mechanism. At 850°C and above complete exchange reactions were observed in 15 to 20 min. Exchange studies with oxygen containing only traces of ^{17}O and ^{18}O indicated reduction in neutron generation. (UK)

33368 EXISTENCE AND NATURE OF THE OXYNITRIDES OF URANIUM. Blum, Pierre-L.; Laugier, Jean; Martin, Jean-Marie; Morlevat, Jean-Pierre (CEN, Grenoble, France). Compt. Rend., Ser. C, 266: 1456-8(May 6, 1968). (In French).

Starting with mixtures of convenient proportions of uranium dioxide and uranium mononitride heated to equilibrium under a nitrogen pressure of 1 atm., there is evidence for new types of oxynitrides of uranium corresponding to the compositions $UO_{2x}N_{1.5}(1-x)$ $(0.5 < x < 1$, UO_2 type) and UNOx $(0 < x\ 0.15$, UN type), of which the nature could be determined definitely. (tr-auth)

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Refer also to abstracts 33208, 33717, 33718, 33855, 34130, 34770, 35312, and 35747.

33369 (AAEC/TM-435) THE PRODUCTION OF ^{18}F FROM REACTOR-IRRADIATED LITHIUM COMPOUNDS. Robson, J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1968. 16p. Dep.

Existing methods of separating ^{18}F produced in reactor-irradiated lithium compounds are reviewed. Direct distillation of ^{18}F from acidified lithium solutions and absorption with the minimum of condensation is shown to be the most satisfactory process for low activities. For remote operation the ^{18}F is separated by absorption on a column of hydrous zirconium oxide followed by elution on passage of an alkaline solution to hydrolyze the complex fluoride. A lower recovery level for ^{18}F on zirconium oxide is compensated by the speed at which this separation can be carried out. The irradiation of lithium hydroxide is recommended for ^{18}F production. A procedure is described in detail for the separation of ^{18}F. (auth)

33370 (AD-662061) SOLUTIONS OF REACTION RATE EQUATIONS PERTAINING TO ELECTRON IRRADIATION OF 4:1 MIXTURES OF N_2 AND O_2. Niles, Franklin E.; Lortie, Edna L. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Sept. 1967. 122p. CFSTI.

One of the Keneshea computer codes was adapted for use on the Ballistic Research Laboratories Electronic Scientific Computer. Using this modified code, reaction rate equations were solved for the following 15 species: e, $NO_2^{(-)}$, $O^{(-)}$, $O_2^{(-)}$, $O_3^{(-)}$, $N_2^{(+)}$, $NO^{(+)}$, $O^{(+)}$, $O_2^{(+)}$, N, NO, N_2O, NO_2, O, and O_3. The calculations were made for a 4:1 mixture of N_2 and O_2 at 1 torr total pressure and 300°K. Rate constants as given by Keneshea and Fowler were used. The solutions are presented as number densities versus time after the start of the irradiating electron beam. A description of the modified code is presented. (auth) (USGRDR)

33371 (AD-662736) PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS. Klein, Nathan; Fanning, James E. Jr.; Warner, John W. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Nov. 1967. 50p. (NDL-TR-96). CFSTI.

X-ray induced aqueous chemical species were examined for reaction characteristics and homogeneous dispersion. A 3 kRAD, 50 ns, x-ray pulse from an electron accelerator produced the hydrated electron, e (−)aq in solutions of Na_2CO_3, $Ba(OH)_2$, H_2SO_4, and $HClO_4$. Kinetic spectroscopy with nanosecond range resolving time measured the optical absorption of e (−)aq but showed no evidence of any nonhomogeneous dispersion of e (−)aq. This indicates that any spur lifetime of e (−)aq is less than 1 ns. The hydrated electron has a rapid, apparent second-order decay in air-free alkaline solutions during the first half microsecond after the x-ray pulse. It is proposed this decay may be due to the reaction of e (−)aq with either H_2O (+) or excited water, H_2O^*. The data are such that neither possible species can be dismissed as less plausible than the other. (USGRDR)

33372 (BNWL-751) ALPHA RADIOLYSIS OF PLUTONIUM (IV): NITRIC ACID SOLUTIONS. Sheppard, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 21p. Dep. CFSTI.

Some of the factors influencing the radiolytic generation of gases from plutonium–nitric acid solutions were investigated. It was found that small but significant amounts of oxygen and hydrogen are generated. The "G" values decrease with increasing nitric acid concentration, are independent of the temperature, and are slightly affected by the atmosphere over the solution. Polyethylene, iron(III), and small concentrations of butyl alcohol have slight but measurable effects on the rate of radiolytic gas generation. A palladium catalyst can control the pressure buildup over a plutonium(IV)–4$\underline{M}$ nitric acid solution for about 4 weeks. Equations are given to calculate the pressure buildup as a function of free volume over the plutonium solution and the isotopic composition of the plutonium. (auth)

33373 (BNWL-SA-1840) LONG-LIVED FREE RADICALS FORMED IN IRRADIATED DYE SOLUTIONS. Kalkwarf, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 29, 1968. Contract AT(45-1)-1830. 17p. (CONF-680608-3). Dep. CFSTI.

From American Chemical Society Meeting, Portland, Ore.

A flow system rapidly passes an aqueous solution of the dye through an 1800-Ci ^{60}Co source into the resonance cavity of a spectrometer. Results indicated that organic structures can be found that can exist as free radicals for days. In general protolytic forms of the radicals that possess a high net charge are more stable, probably due to the effect of Coulombic repulsion between radicals. (M.C.G.)

33374 (CEA-tr-X-635) INFLUENCE DU RAYONNEMENT GAMMA SUR LES PROPRIETES DE QUELQUES POLYMERES PELLICULAIRES. (Effect of gamma Rays on the Properties of Several Plastic Films). Jedlinski, Z.; Hippe, Z.; Zurokowska-Orszagh, J. Translated into French from Przem. Chem., 42: 365-8(1963). 15p. Dep.

This paper was previously abstracted from the original language and appeared in NSA as 17: 36362. (M.C.G.)

33375 (COO-1528-26) RADIATION CHEMISTRY RESEARCH. technical Progress Report, September 1, 1967–August 31, 1968. Kevan, Larry (Kansas Univ., Lawrence. Dept. of Chemistry). May 17, 1968. Contract AT(11-1)-1528. 21p. Dep. CFSTI.

Developments are reported for studies on: paramagnetic relaxation in methanol and methyltetrahydrofuran glasses; radiolysis of frozen solutions; charge transfer reactions in fluorocarbons; electron ionization cross sections for substituted fluorocarbons; and liquid phase vacuum uv photolysis of propane. (P.C.H.)

33376 (DP-MS-66-85) RADIATION-INDUCED DECOMPOSITION OF CHLOROFORM AT HIGH DOSE RATES. Bibler, N. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Dec. 7, 1966. Contract AT(07-2)-1. 7p. (CONF-670401-14). Dep. CFSTI.

From 153rd National Meeting, American Chemical Society, Miami Beach, Fla.

A pulsed x-ray generator was used to study the radiolysis of pure, air-free liquid $CHCl_3$ at dose rates of 10^{10} RADS/sec. The 100-eV yields of the major organic products, $C_2H_2Cl_4$, C_2HCl_5, and C_2Cl_6, are 1.3, 1.0, and 0.5, respectively. On the basis of a proposed free-radical mechanism, the observed yield of $CHCl_2$, a primary free radical, is 3.6 radicals/100 eV. By comparison with published data obtained at lower radiation intensities, high dose rates are shown to favor radical-radical reactions at the expense of radical-solvent reactions. Specifically, the rate of the back reaction of Cl atoms and $CHCl_2$ radicals to reform $CHCl_3$ increased, and the rate of Cl atoms with $CHCl_3$ decreased at this high dose rate, thus lowering the net decomposition of chloroform. (auth)

33377 (KFK-tr-238) DER EINFLUSS VON ORGANISCHEN HALOGENIDEN AUF DIE AUSBEUTE AN WASSERSTOFF BEI DER γ-RADIOLYSE VON METHANOL. (The Influence of Organic Halides on the Hydrogen Yield from the γ Radiolysis of Methanol). Matsuoka, Haruko; Sato, K.; Masuda, T.; Kondo, M. Translated into German by Peter Buriks (Kernforschungszentrum, Karlsruhe, Ger.), from Nippon Kagaku Zasshi, 87: 1320(1967). 10p. JCL $1.10 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 4569.

33378 (ORNL-tr-1929) INFLUENCE OF IONIZING RADIATION ON THE CHEMICAL AND SUPERMOLECULAR STRUCTURE OF CELLULOSE. Polcin, Jan. Translated for Oak Ridge National Lab., Tenn., from Jad. Energ., 13: 145-9(1967). 14p. (CONF-660575-1). Dep. CFSTI.

From 6th Radiation Chemistry Seminar, Smolensk, USSR.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 30466.

33379 (TID-4050(1st. Ed.)) SUMMARIES OF THE USAEC BASIC RESEARCH PROGRAM IN CHEMISTRY (ON-SITE). (Division of Research (AEC), Washington, D. C. Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). June 1968. 252p. Dep. CFSTI.

Indexes Prepared by Division of Technical Information Extension (AEC), Oak Ridge, Tenn.

Information is presented on current projects being supported by the Office of Chemistry Programs of the Division of Research under its on-site program. The objectives and current status of individual research efforts in effect during 1967 are summarized. The summaries are arranged by laboratory and then by the following subdiscipline categories: heavy element chemistry, nuclear chemistry, radiation chemistry, photochemistry, and hot atom chemistry, isotope effects, structural and theoretical chemistry, high temperature chemistry, inorganic chemistry, physical chemistry, analytical chemistry, geochemistry, separation chemistry, and nuclear chemical engineering. Investigator and subject indexes are included. (M.C.G.)

33380 (UCRL-17989(Suppl.)) INDEX TO NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1967. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1968. Contract W-7405-eng-48. 48p. Dep. CFSTI.

A permuted index of key words and numbers contained in the titles of the papers in the Nuclear Chemistry Division Annual Report, 1967; authors' surnames are also indexed. The index was prepared by an IBM-1401 computer by means of the KWPT (Key Words Plus Title) program. (M.C.G.)

33381 PRODUCTION BY RADIATION METHODS OF SELF-SHRINKING POLYETHYLENE FILMS. Braslin'sh, U. E.; Kal'kis, V. Ya.; Rayavee, E. L.; Laukevits, Ya. Ya. Plast. Massy, No. 4, 39-40(1968). (In Russian).

Results of the determination of optimum parameters for production of self-shrinking polyethylene films by γ irradiation methods are reported. The optimum temperature and exposure time of the preliminarily expanded and irradiated polyethylene film during its shrinkage were determined. (tr-auth)

33382 PREPARATION OF CURIE AMOUNTS OF $^{234}Th(UX_1)$ AND MILLICURIES OF $^{234}Pa(UZ)$ BY EXTRACTION OF ^{238}U. Bjoernholm, S. (Univ. of Copenhagen); Westgaard, L.; Mason, T.; Nielsen, H. L. Radiochim. Acta, 8: 204-6(Dec. 1967).

The extraction of Th from several tons of ^{238}U was undertaken at the Springfield Works, resulting in a 0.8 Ci concentrate of ^{234}Th contained in one liter. Subsequent extraction of the weakly populated isomer of ^{234}Pa, UZ, yielded samples of 0.5 to 1 mCi, which were prepared as weightless sources for high resolution electron spectrometry. (auth)

33383 PULSE RADIOLYSIS STUDIES ON STABLE AND TRANSIENT COMPLEXES OF PLATINUM. Adams, G. E. (Mt. Vernon Hospital, Northwood, Eng.); Broszkiewicz, R. B.; Michael, B. D. Trans. Faraday Soc., 64: 1256-64(May 1968).

Pulse radiolysis studies on aqueous solutions of platinum complexes revealed several transient spectra. Oxidation of Pt(II) (as $[PtCl_4]^{2-}$) resulted in the sequential formation of two short-lived complexes of Pt(III), one of which can be formed directly by the reaction between e_{aq}^- and Pt(IV) ($[PtCl_6]^{2-}$). A short-lived species of Pt(I) was produced by reduction of Pt(II). The relationships between the spectra were studied as a function of solute concentration, oxygen and N_2O content, and pH. The stereochemistry of the transient species is discussed. (auth) (UK)

33384 KINETICS OF RADIOINDUCED HYDROGEN ABSTRACTION FROM THYMINE. **Heitkamp, D.; Merwitz, O.; Spaeth, H. (Institut fuer Radiochemie, Karlsruhe, Ger.). Z. Naturforsch., 26b: 403-12(Apr. 1968). (In German).**

In connection with the measurements of the tritium abstraction from γ-irradiated thymine-(methyl-T) and thymine-6-T, a kinetic model for the reactions occurring during the irradiation was discussed. The dose-effect curves calculated on the basis of this model agree very well with the measured curves in the dose range from 10^5 to 5×10^8 rad. (tr-auth)

33385 FORMATION OF EXCITED STATES IN THE PULSE RADIOLYSIS OF SOLUTIONS OF AROMATIC COMPOUNDS IN CYCLOHEXANE AND BENZENE. **Land, E. J.; Swallow, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Trans. Faraday Soc., 64: 1247-55(May 1968).**

Measurements were made on the triplet absorptions produced on irradiation of solutions in cyclohexane and benzene. Triplet yields were determined using the most recent extinction coefficient estimates. The yields were: Anthracene—in cyclohexane, G = 0.2 (10^{-4} $\underline{M}$) to G = 1.05 (10^{-2} $\underline{M}$); in benzene, G = 0.15 (10^{-4} $\underline{M}$) to G = 1.5 (5×10^{-2} $\underline{M}$). Naphthalene—in cyclohexane, G = 0.25 (10^{-4} $\underline{M}$) to G = 2.4 (9×10^{-1} $\underline{M}$); in benzene, G = 0.4 (10^{-3} $\underline{M}$) to G = 2.3 (1 $\underline{M}$). Benzophenone—in cyclohexane (ketyl radical), G = 0.4 (10^{-4} $\underline{M}$) to G = 4.8 (1 $\underline{M}$); in benzene, G = 0.15 (10^{-4} $\underline{M}$) to G = 3.2 (1 $\underline{M}$). Emission measurements were also made on these solutions. Dilute naphthalene in cyclohexane and benzene gave monomer fluorescence, but at higher concentrations emission due to excimer was also seen. Allowing for excimer formation, the concentration dependence of fluorescence in cyclohexane was similar to that of the triplet states. In benzene the rise in naphthalene fluorescence was less than the rise in triplet yield. For cyclohexane solutions, solute triplet states are believed to be formed mainly through neutralization of solute ions, some directly, and some via the intermediate formation of solute singlet states. A similar mechanism may operate in concentrated solutions in benzene, but in dilute solutions, solute triplets may also be formed via singlet and triplet states of the solvent. (auth) (UK)

33386 RADIATION-INDUCED POLYMERIZATION OF VINYLPHOSPHONIC ACID DERIVATIVES. **Fujii, Shigetada (Government Industrial Research Inst., Nagoya, Japan). J. Sci. Hiroshima Univ. Ser. A-II, 31: 89-110(Aug. 1967).**

The mechanism of γ-ray induced polymerization of bis-β-chloroethyl vinylphosphonate (CEVP) was studied kinetically in the bulk- and solution-polymerizations and the copolymerization with styrene and methyl methacrylate. Furthermore, to clarify the characteristics of polymerization in detail, the bulk-polymerization of vinylphosphonic acid dichloride (VPAC) in solid and liquid states was investigated. The bulk-, solution- and co-polymerization of CEVP proceed on the free radical mechanism and a remarkable chain transfer reaction seems to occur in these reactions, forming the polymers of low molecular weight. The polymerization of VPAC in solid state seems to proceed on the ionic mechanism, though the polymerization in liquid state takes the free radical mechanism. In the bulk polymerization of CEVP, the unimolecular termination reactions occur mainly, whereas in the solution polymerization it has a bimolecular termination mechanism due to the primary solvent radical in the wide range of the monomer concentration. In the copolymerization of CEVP, the reaction proceeds on a bimolecular termination mechanism almost over the whole range of the CEVP monomer concentration. (auth)

33387 EFFECT OF ADDITIVES ON THE RADIATION-INDUCED POLYMERIZATION OF BUTADIENE IN EMULSION. **Gervasi, J. A.; Dudley, B. J.; Stannett, V. (Research Triangle Inst., Durham, N. C.). J. Polym. Sci., Part B, 6: 281-4(Apr. 1968).**

The effects of a number of additives on the structure of emulsion polydienes produced by radiation were investigated. Butadiene was chosen as the model diene. The following additives were investigated at 25°C and with the stated percentage amount on the weight of butadiene: tetrahydrofuran 3.2%; dimethyl sulfoxide 1.6%; dimethylformamide 1.4%; morpholine 1.1%; aminoethanol 0.7%; urea 0.74%; ethanolamine 5%; and 0.5 to 1.0% of the following compounds: palladous cyanide; potassium hexachloropalladate; ruthenium trichloride; cobalt octanoate; tetrabutyl titanate; dicyclopentadienyl dichloride; vanadium acetylacetonate; triphenylphosphine; cobaltous fluorosilicate; di-tert-dodecyl disulfide; and rhodium trichloride. Only the last compound caused any change in the structure of the resulting polybutadiene and this compound, rhodium trichloride, was examined in more detail. It was found that with rhodium trichloride even 0.08% gave essentially all-trans polymer compared with about 60% trans without the addition of rhodium trichloride. The results indicate that something different from a normal free radical process is involved. (P.C.H.)

33388 INVESTIGATION BY THE EPR METHOD OF THE RADICAL PRODUCTS OF THE RADIOLYSIS OF FROZEN AQUEOUS SOLUTIONS OF $HClO_3$, $NaClO_3$, AND $NaClO_2$. **Belevskii, V. N.; Bugaenko, L. T. (Moscow State Univ.). Zh. Neorg. Khim., 13: 948-51(Apr. 1968). (In Russian).**

The radicals formed during the irradiation of concentrated solutions of sodium chlorite and chlorate, chloric acid, and pure sodium chlorite were investigated at −196°C by the EPR method. It was found that in chloric acid and chlorate matrices, the radicals ClO_3 and ClO_2 were formed during irradiation and in chlorite matrix the radical ClO_2 is formed. A mechanism for the formation of these radicals was proposed. (tr-auth)

33389 EFFECT OF PHOTOCHEMICAL PROCESSES ON THE LUMINESCENT PROPERTIES OF URANIUM(VI) IN $NaClO_4$ SOLUTION. **Dobrolyubskaya, T. S.; Anikina, L. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim., 13: 1208-10(Apr. 1968). (In Russian).**

The effect of ultraviolet radiation on frozen solutions of U(VI) containing additions of $NaClO_4$ shows a significant decrease of the intensity of the luminescence which is connected with the photochemical decomposition of the uranyl perchlorate, apparently, to UO_3. (tr-auth)

33390 EFFECTS OF REACTOR IRRADIATION ON TIME-TEMPERATURE DEPENDENCE OF THE STRENGTH OF POLYMERIDES. **Velikovskii, A. A.; Tynnyi, A. N.; Karasev, V. S.; Mikitishin, S. I. (Inst. of Physics, Kiev. Inst. of Physics and Tech., Lvov). Fiz.-Khim. Mekh. Mater., 4: 30-2(1968). (In Russian).**

The ultimate strength of polymers (polymethyl methacrylate, cellulose triacetate, and polyethylene terephthalate) irradiated by 10^{14}n/cm^2·sec thermal neutrons and 10^{13}n/cm^2·sec fast neutrons with a maximum dose of 60,000 rad/sec was investigated. It was found that the time dependence of the strength of irradiated polymers is expressed by the S. N. Zhurkov equation: $\tau = \tau_0 \cdot e^{U_0 - \gamma\sigma/kT}$. The exposure of examined polymers to irradiation resulted in increased coefficient γ, and with the increase of absorption dose, the activation of elementary disintegration process U_0 was increased in linking polymers and reduced in the broken nonlinked polymers while in the crystalline polymers it remained unchanged. (R.V.J.)

33391 PRODUCTION OF NEUTRON DEFICIENT RARE EARTH ISOTOPES FROM GADOLINIUM AND NEODYMIUM IRRADIATED WITH 680-MeV PROTONS. **Molnar, F.; Lebedev, N. A. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 197-204(1968). (In Hungarian).**

For the isolation of neutron deficient rare earth isotopes as a group from gadolinium and neodymium targets irradiated with high energy protons, an anion exchange method was developed. The method is based on the anion exchange adsorbability of the rare earth elements from aqueous methanol solution of nitrates. The separation of the rare earth isotopes from one another can be carried out by conventional cation exchange method using ammonium α-hydroxyisobutyrate as eluent. (auth)

33392 RAPID MILKING SYSTEM FOR OBTAINING 57-MIN ^{103m}Rh. **Bedrossian, P.; Lengyel, T.; Toerkoe, J. (Inst. of Isotopes, Budapest). Atompraxis, 14: 193-5(Apr.–May 1968).**

An isotope generator yielding 57-min ^{103m}Rh is described. Because of the relatively short half-life, a liquid ion exchanger is used for separation of the daughter from the ^{103}Pd mother element. Radioactive purity of the product obtained is checked with the aid of a 256-channel pulse-height analyzer. Possibilities of measuring soft X_K rays are briefly discussed. (auth)

33393 ELECTRON ABSORPTION SPECTRA AND EPR SPECTRA OF IRRADIATED SILICATE GLASS. **Sidorov, T. A.; Tyul'kin, V. A. Teor. Eksp. Khim., 4: 96-101(Jan.-Feb. 1968). (In Russian).**

The electron absorption spectra in the visible region of sodium silicate glasses and the EPR spectra of two-component alkali silicate glasses, irradiated with γ radiation, were investigated. It was established that the electron absorption spectra of these glasses have in the visible region two bands, and the EPR lines with $\underline{g}$ = 2.01 consist of two components. The comparison of the data on the optical absorption spectra with the EPR spectra shows that the bands with maximum of only 4400 Å and β-component of the doublet with $\underline{g}$ = 2.01 pertains to one and the same hole center of the type Si – $O^{\oplus}$ . . . Me^+, and bands with maximum of only

6200Å and α-component of the doublet pertains to hole centers of the type $Si - O^{-\oplus}$. The change of the ratio of the intensities of the α and β components is explained by the change of the concentration and type of alkali metals. (tr-auth)

33394 FORMATION OF PEROXIDE COMPOUNDS DURING RADIOINDUCED OXIDATION OF VARIOUS HYDROCARBONS. Saraeva, V. V.; Sydykova, D. S. Vestn. Mosk. Univ., Ser. II. Khim., No. 6, 78-80(Nov.-Dec. 1967). (In Russian).

The influence of the structure of the hydrocarbons on the x-radiation-induced formation of hydrogen peroxides and peroxides at +70 to 80°C was studied using cyclohexane, cumene, and isooctane at doses of 1×10^{16} to 1.4×10^{16} eV/ml/sec. Data obtained revealed that at ~70 to 80°C the formation of hydrogen peroxides was developed by chain processes. Cumene peroxides formed at comparably low doses $\sim 2 \times 10^{19}$ eV/ml, dialkyl peroxides formed from isooctane at higher doses of $\sim 1 \times 10^{20}$ eV/ml. (R.V.J.)

33395 RADIATION YIELDS OF RADICALS IN SOLID ORGANIC MATERIALS CONTAINING HETEROATOMS. Trofimov, V. I.; Chkheidze, I. I.; Belen'kii, L. I.; Buben, N. Ya. (Inst. of Chemical Physics, Moscow). Teor. Eksp. Khim., 4: 90-5(Jan.-Feb. 1968). (In Russian).

The radiation yields of radicals (G_R) in organic compounds of different classes, containing heteroatoms were measured by the EPR method. The compounds studied were dialkyl disulfides, diphenyl and dibenzyl disulfides, alkyl derivatives of thiophene, thiophene carbonaceous acids, halide derivatives of thiophene, and saturated heterocyclic compounds with atoms of nitrogen, oxygen, and sulfur. It was shown that (1) in the saturated disulfides and cyclic sulfides $G_R = 0.2$ to 11/100 eV, whereas in corresponding hydrocarbons, alcohols, oxides, and alkylene imines $G_R = 3$ to 81/100 eV; (2) the introduction of sulfur atoms in the aromatic compounds does not change the radiation stability; (3) disturbance of the connection of the halide atoms and the carboxyl groups with thiophene ring leads to decrease of the radiation stability. It was assumed that an increase of the stability of sulfur-containing compounds can be connected with excitation of the electrons of the S atom in the d orbitals, which in the sulfur atoms are significantly higher than in oxygen, nitrogen, and carbon atoms, and with the subsequent dissipation of the excitation energy. (tr-auth)

33396 CHEMICAL EFFECTS OF RADIATIVE THERMAL NEUTRON CAPTURE. PART XV. THE EFFECT OF ANION VACANCIES. Milenkovic, S. M. (Boris Kidrich Inst. of Nuclear Sciences, Vinca, Yugoslavia); Maddock, A. G. Radiochim. Acta, 8: 222-3(Dec. 1967).

Phosphate-doped potassium chromate shows little difference in retention from the A.R. chromate over the concentration range 10^{-4} to 10^{-1} mole %. The doped crystals were rather less sensitive to thermal annealing than the pure chromate. These results suggest that the role of cation vacancies more likely involves electron trapping than simply facilitating movements in the lattice. (auth)

33397 STUDIES OF IRRADIATED POLYMETHYL METHACRYLATE ABSORPTION COEFFICIENT. Shcherba, N. D.; Mikitishin, S. I.; Tynnyi, A. N. (Physical-Mechanical Inst., Lvov). Fiz.-Khim. Mekh. Mater., 4: 33-5(1968). (In Russian).

Experimental data were obtained on absorption coefficients of irradiated polymethyl methacrylate (PMM) as a function of the specimen thickness, and an empirical expression describing this function was developed. The energy of ultraviolet irradiation was about 5×10^4 erg/sec cm^2. (R.V.J.)

33398 INFLUENCE OF METAL OXIDES ON RADIOLYSIS OF POTASSIUM AND SODIUM NITRATES. Zakharov, Yu. A.; Nevostruev, V. A. (Tomsk Polytechnic Inst., USSR). Zh. Fiz. Khim., 42: 1156-60(May 1968). (In Russian).

It was shown that the size of irradiated potassium and sodium nitrate crystals influenced the yields of gaseous and solid products. It was also shown that semiconductor impurities (ThO_2, NiO, CoO, ZnO, and ZnO with Li and Al ion additions) can be used for inhibiting the rate of solid salt radiolysis. (R.V.J.)

33399 RESEARCH AND RESEARCH RESOURCES AT STUDSVIK. Holte, G.; Svenke, E. (Aktiebolaget Atomenergi, Stockholm). Tek. Vetensk. Forsk., 38: 101-7(1967). (In Swedish).

The scientific and technical resources at the Nuclear Research Establishment of AB Atomenergi, Studsvik, are described. Examples are given on facilities for research, development and education in various fields not necessarily related to nuclear energy. Studsvik is equipped for the following main activities: materials research and development, physics research, chemical research, radiation protection research, and reactor development. (auth) (Sweden)

33400 USE OF ELECTROPHORESIS AND CHROMATOGRAPHY FOR THE SEPARATION AND QUANTITATIVE DETERMINATION OF RADIOACTIVE IRIDIUM COMPOUNDS IN NORMAL AND CARRIER-FREE AMOUNTS. van Ooij, W. J.; Houtman, J. P. W. (Reactor Instituut, Delft, Netherlands). Z. Anal. Chem., 236: 407-18(1968).

Electrophoretic and chromatographic methods were applied to the analysis of aqueous solutions of aquohalo complexes of trivalent and tetravalent iridium, labeled with ^{192}Ir. For Ir^{III} containing complexes good results were obtained using high-voltage paper electrophoresis, whereas the corresponding Ir^{IV} complexes are liable to reduction by the paper. Therefore, electrophoretic and chromatographic techniques on thin layers of silica gel N-HR and cellulose were developed. Quantitative measurements were carried out by means of autoradiography, using a set of films of regularly increasing sensitivity. By these methods the hydrolysis behavior of some of the complexes of Ir^{IV} in aqueous solution was investigated. The TLC and TLE methods were also applied to solutions of the complexes in carrier-free concentrations ($<10^{-12}$ mole/liter), obtained by the Szilard–Chalmers process in K_2IrCl_6 and K_3IrCl_6. By means of TLE on silica gel layers 20 carrier-free products were found and determined in a solution of irradiated K_2IrCl_6. About the same amount of products was found in a solution of irradiated K_3IrCl_6, using a two-dimensional combination of TLE and TLC. In this case some additional information was obtained about the chemical composition of the carrier-free compounds, as the separation by TLC seems to depend on the number of water ligands in the complexes, whereas the separation by TLE depends only on the electric charge and the size of the ions. (auth)

33401 PHOTOCONDUCTIVITY PROCESSES IN LOW MOBILITY ORGANIC MATERIALS. Coppage, F. N.; Kepler, R. G. (Sandia Lab., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 127-9(Dec. 1966). (SC-R-66-945).

Recent results obtained on anthracene crystals make it possible to calculate the number of carriers created in polymers when they are subjected to high energy radiation. These results are described and applied to some recently reported measurements on polystyrene. Reasonable values are found for such quantities as carrier mobility and trap densities. (auth)

33402 METHOD FOR EMULSION-POLYMERIZING ETHYLENE TETRAFLUORIDE OR TRIFLUOROCHLOROETHYLENE. Yoneya, Minoru (to Daikin Kogyo Co., Ltd.). Japanese Patent 1967-24179. Nov. 21, 1967. Filed May 18, 1963.

The advantages of the method are the effective liquid-phase polymerization while inhibiting the gas-phase one and the extremely small polymer particle sizes. In the emulsion polymerization of tetrafluoroethylene or chlorotrifluoroethylene in the aqueous medium, an anion activating agent other than the high-fluorinated or high-fluorinated high-chlorinated alkyl systems is used as the dispersion agent. The polymerization reaction in the presence of liquid hydrocarbon produces polymers containing more than 12 carbons by irradiation with ionizing radiation. (NSA of Japan)

33403 RADICAL GRAFTING ON LIGNIN. PART I. RADIATION-INDUCED GRAFTING OF STYRENE ONTO HYDROCHLORIC ACID LIGNIN. Koshijima, Tetsuo; Muraki, Einosuke (Government Industrial Research Inst., Osaka). J. Polym. Sci., Part A-1, 6: 1431-40(June 1968).

By irradiation with gamma rays styrene was grafted onto hydrochloric acid lignin. When the graft polymers were subjected to nitrobenzene oxidation, the vanillin yields indicated two kinds of reaction occurring in the grafting. Polystyrene branches were separated from the graft polymers, and their $\overline{M}_n$ were determined osmometrically. At grafting ratios of up to 100 the vanillin yields diminished proportionately with increasing grafting, and the $\overline{M}_n$ of the branches, 5000, was unchanged. At grafting ratios of more than 100 the vanillin yields were constant, independent of the ratios, but the $\overline{M}_n$ values of the branches increased with grafting. Paper chromatography of the aromatic acids obtained by oxidation of methylated lignin and the graft polymer indicated that isohemipic and metahemipic acids were more abundant in the acid fraction of the graft polymer than in the lignin itself. A qualitative mass analysis of the gaseous products evolving from the irradiated lignin showed the presence of hydrogen molecules only. Gamma radiation brought about no change in the yields of vanillin. It was therefore concluded that radiation grafting on lignin at grafting ratios of less than 100 proceeded through the addition of styrene polymer radicals to the aromatic nuclei of the lignin and that then branches propagated from the aliphatic part of the lignin, where C–H bond scission had been caused by the irradiation. The grafting sites of lignin would be C-5 and C-6 of the guaiacyl nucleus and, probably the β and γ carbon atoms of the aliphatic side chain of the lignin. (auth)

33404 RAPID TIME SCALE FOR HYDROGEN-ATOM ABSTRACTION BY RECOIL TRITIUM ATOMS. NONEQUILIBRIUM ALLYL RADICALS FROM PROPYLENE. Tachikawa, Enzo; Tang, Yi-noo; Rowland, F. S. (Univ. of California, Irvine). J. Amer. Chem. Soc., 90: 3584-5(June 19, 1968).

The HT yield from the recoil tritium abstraction reaction with the CH_3 group of propylene was measured and compared to well-established correlation of hydrocarbon bond dissociation energies with such hydrogen abstraction yields. The discrepancy between this apparent value for the allyl-H bond dissociation energy (93 kcal/mole) and the measured values by other well-established techniques (87.8 kcal/mole) led to the conclusion that the equilibrium bond dissociation energy was not appropriate for such a comparison in this particular situation. Data is reported for abstraction yields from recoil tritium reactions with propylene in excess perfluorocyclobutene. (D.H.M.)

33405 RADIOLYSIS OF LIQUID n-PENTANE. Koch, R. O.; Houtman, J. P. W.; Cramer, W. A. (Reactor Instituut, Delft, Netherlands). J. Amer. Chem. Soc., 90: 3326-33(June 19, 1968).

The radiation-induced decomposition of liquid n-pentane was studied as a function of temperature and total dose. Effects of olefins, oxygen, and nitrous oxide on product formation were also investigated. At room temperature, rupture between a primary and a secondary carbon atom occurs with a G value of 0.3 and between two secondary carbon atoms with a G value of 1.2. The total yield of C–C rupture was found to be temperature dependent, with G values of 1.7, 1.5, and 1.0 at temperatures of 95, 20, and –116°C, respectively. Unsaturated products with six to ten C atoms, formed at low doses, are suggested to result from reactions within the spurs. Isomerization of radicals, though occurring, is relatively unimportant. Effects of an increase in radiation dose are attributed to the accumulation of olefins in the irradiated liquid. It is concluded that these olefins not only scavenge radicals and atoms, but that they are also involved in other processes. Similarly, the reduction in hydrogen yield in the presence of pentene is only partly due to scavenging of H atoms. Positive ions probably contribute to polymer formation in these solutions. Effects of oxygen and of nitrous oxide indicate that saturated products are mainly formed in reactions involving free radicals, whereas a considerable fraction of C_2-C_4 olefins are produced by molecular elimination. Positive ions are among the intermediates in the formation of these olefins. (auth)

33406 METHOD FOR PRODUCING RADIOISOTOPE ^{28}Mg. Kawai, Naoyuki (to Nippon Atomic Industrial Group Co., Ltd.). Japanese Patent 1967-24634. Nov. 27, 1967. Filed Apr. 20, 1964.

A method is proposed for producing ^{28}Mg of high purity and with high specific activity. Magnesium oxide, containing ^{26}Mg, was irradiated with an accelerated triton beam; then, radioactive impurities produced in the irradiated oxide were removed by chemical treatment. (NSA of Japan)

33407 METHOD FOR POLYMERIZING TETRAFLUOROETHYLENE. Okamura, Kazuo (to Daikin Kogyo Co., Ltd.). Japanese Patent 1967-26701. Dec. 18, 1967. Filed Mar. 31, 1962.

The method proposed has the following advantages: continuous, simple, and high-yield production; extremely small particle sizes, about 1 to several μ, approximately spherical; void-less product; etc. Tetrafluoroethylene is polymerized in the gas phase by irradiation with ionizing radiation at 1×10^3 to 1×10^5 R/hr to a total dosage of below 1×10^6 R, at a temperature from 0 to 60°C and a pressure from 0 to 10 kg/cm^2. Tetrafluoroethylene is then fed continuously under constant pressure, and the produced polymer is drawn out also continuously. (NSA of Japan)

33408 METHOD FOR PRODUCING FOAMED POLYPROPYLENE. Kamiyama, Mamoru (to Hitachi Ltd.). Japanese Patent 1967-26953. Dec. 20, 1967. Filed July 4, 1964.

Some features of the product, obtained by the method, are: stability of the (product) shape, superior mechanical properties including tensile strength etc., superior chemical properties including anti-chemicals etc., high adhesion, etc. A resin molding, containing polypropylene and/or its derivative, a multifunctional monomer and a foaming agent, was irradiated with ionizing radiation to give bridging to the resin. The agent was dissociated by heating to give the foamed product. In an alternate method the bridging and the foaming are done simultaneously. (NSA of Japan)

33409 IONIC SPECIES IN THE RADIOLYSIS OF CYCLOHEXANE. Sata, Shin (Tokyo Inst. of Tech.). Bull. Chem. Soc., Jap., 41: 304-6(Feb. 1968).

A diffusion model proposed previously was applied to explain the ionic reactions occurring in the γ-radiolysis of cyclohexane. The effects of an electron scavenger (N_2O) and a positive ion detector (CH_3OD) were consistently interpreted. The ratio of the diffusion coefficient of electrons to that of parent positive ions was estimated to be in the range of 4 to 5. The calculating method was compared with that recently published by Freeman (J. Chem. Phys., 46: 2822(1967)). (NSA of Japan)

33410 γ-RADIATION INDUCED COLOR CENTERS IN ANTHRACENE. Blum, Haywood; Mattern, P. L.; Arndt, R. A.; Damask, A. C. (Brookhaven National Lab., Upton, N. Y.). Mol. Cryst., 3: 269-80(Nov. 1967).

The effects of γ irradiation on pure anthracene were investigated by optical absorption and electron paramagnetic resonance measurements. After irradiation, annealing of the crystals was carried out isochronally using steps of 10°C, starting at 40°C, and 45-min intervals. The optical absorption peaks produced by the radiation at 30°C are stable at 30°C but increase upon annealing up to 140°C; the most prominent of these are at 6060 Å and 5350 Å. Paramagnetic resonance signals arising from irradiation are stable to 140°C but do not grow between 30 and 140°C. Both optical density and ESR signals decrease upon annealing above 190°C. A model is proposed to explain the nature of the ESR signals based upon cross-linking of the anthracene molecules. (BBB)

33411 EFFECT OF HIGH ELECTRIC FIELD ON RADIOINDUCED POLYMERIZATION OF STYRENE AT ROOM TEMPERATURE. Ueno, Katsuji; Hayashi, Koichiro (Kyoto Univ.). Kogyo Kagaku Zasshi, 71: 470-1(Mar. 1968). (In Japanese).

Radioinduced cationic polymerization of bulk styrene was studied under high electric field. It was found that the rate of polymerization at 25°C increases with application of the electric field of 6 kV/cm, and decreases at a higher electric field. These results are interpreted in terms of the increase of free ions and the relative life-time of both positive ions (growing chains) and negative ions under high electric field. (NSA of Japan)

33412 ROLE OF THE VOLUME OF THE SOLID SUBSTANCE IN THE RADIATION ADSORPTION OF HYDROGEN ON γ-Al_2O_3. Dolidze, G. M.; Kolbanovskii, Yu. A.; Polak, L. S. (Inst. of Physics, Tbilisi, USSR). Khim. Vys. Energ., 2: 99–100(Jan.–Feb. 1968). (In Russian).

The role of the volume of the solid substance was investigated using the radiation chemisorption of hydrogen on samples of γ-Al_2O_3 with different specific surfaces. The data obtained showed the role of volume effects in the surface phenomena observed in an irradiation field. (J.S.R.)

33413 RADIATION CHEMISORPTION OF OXYGEN ON DIFFERENT SAMPLES OF ALUMINUM OXIDE. Gezalov, A. A.; Zhabrova, G. M.; Spiridonov, K. N. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 81-7(Jan.-Feb. 1968). (In Russian).

The radiation chemisorption of oxygen on different samples of Al_2O_3 was investigated at 20°C. It was found that oxygen, chemisorbed on previously irradiated samples, does not affect the chemisorption in the radiation process. Chemisorption ceases during stopping of the irradiation and after repeated stopping of the irradiation continues with the same rate as in the moment of stopping. The rate of radiation chemisorption on samples with previous thermal chemisorption of oxygen (at 320°C) did not change. The data obtained were treated from the viewpoint of the fate, in the radiation chemisorption process, of surplus electrons, formed in the aluminum oxide by γ radiation. The original rate of oxygen chemisorption did not depend on the size of the specific surface of the sample and the phase state. The diffusion of the surplus current carriers, formed under the effect of γ radiation, did not limit the chemisorption process. A linear dependence of the chemisorption rate on the size of the specific surface was observed for three Al_2O_3 samples. A possible explanation of this character of the radiation chemisorption process of oxygen on Al_2O_3 was proposed. (tr-auth)

33414 EFFECT OF γ IRRADIATION ON THE COPOLYMER OF ETHYLENE WITH α–BUTYLENE. Dzhibgashvili, G. G.; Slovokhotova, N. A.; Leshchenko, S. S.; Karpov, V. L. Khim. Vys. Energ., 2: 101-2(Jan.–Feb. 1968). (In Russian).

During the study of the ir spectrum of γ-irradiated films of ethylene copolymer with 3 mole % α-butylene, the formation was observed not only of trans-unsaturated double bonds but the formation of the final vinyl group. The intensity of the 910 cm^{-1} band in the spectrum of the sample irradiated at liquid nitrogen temperature at doses of 58 Mrad corresponded with the intensity of the same band in the spectrum of samples irradiated at room temperature at doses of 300 MRAD. The yield of trans-unsaturated double bonds in the irradiation at doses of 58 MRAD at room temperature was greater than that in the irradiation at the same dose at liquid nitrogen temperature. (J.S.R.)

33415 THE QUESTION OF THE ROLE OF TRANS-VINYLENE UNSATURATION IN PROCESSES OF RADIATION LINKING OF POLYETHYLENE IN THE PRESENCE OF POLYFUNCTIONAL MONOMERS. Braginskii, R. P.; Leshchenko, S. S.; Finkel, E. E. Khim. Vys. Energ., 2: 100-1(Jan.-Feb. 1968). (In Russian).

The effects of trans-vinylene unsaturation in polyethylene of high density on radiation linking processes under the effects of ^{60}Co γ radiation in the presence of allyl methacrylate was investigated. The allyl methacrylate was introduced to the trans-vinyl unsaturates and the mixture was irradiated at doses of 1 MRAD. The evaluation of the degree of linking showed that is independent of the amount of trans-vinylene unsaturation in the original sample. (J.S.R.)

33416 CALORIMETRIC STUDY OF THE RADIATION POLYMERIZATION OF SOLID ACRYLONITRILE IN THE TEMPERATURE RANGE FROM 80 TO 180^0K. Kritskaya, D. A.; Ponomarev, A. N.; Tal'roze, V. L. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 61-5(Jan.-Feb. 1968). (In Russian).

Polymerization in a layer of frozen acrylonitrile, occurring immediately at the time of irradiation of the monomer with electrons at 2 keV in the temperature range from 80 to 180°K, was studied with an adiabatic microcalorimeter with a sensitivity of 10^{-6} cal/sec. It was found that the polymerization with a radiation yield $G > 5$ of the addition events per 100 eV of absorbed energy occurs only at the temperatures of 110, 138, and 160°K, during which the phase transformation of fast-frozen acrylonitrile was observed. It was also found that the active particles, obtained by irradiation of acrylonitrile at 77°K, with subsequent annealing of the samples, initiates post-polymerization. Its depth increases with the residence time of the sample in the area of phase transformation. (tr-auth)

33417 OXIDATION OF RUBBER UNDER THE EFFECTS OF ^{60}Co RADIATION. Degteva, T. G.; Kuz'minskii, A. S.; Klimenko, G. K.; Novgorodova, E. Z. (Scientific Research Inst. of the Rubber Industry, Moscow). Khim. Vys. Energ., 2: 71-6(Jan.-Feb. 1968). (In Russian).

A comparison was made of the radiation (at room temperature) and thermal (100°C) oxidation of butadienenitrile rubber in order to establish the character of the oxidation process under the effects of ^{60}Co radiation in rubber. It was established that in both cases the oxidation kinetics have a similar character; the same oxygen-containing groups are formed in the rubber; the nitrile groups and double bonds of the same type ($-CH=CH_2-$ and $-CH=CH-$) are broken up. Rubber peroxides in vacuum were decomposed under the effects of irradiation. The data obtained and the dependence of the oxidation rate on the dose confirmed that the oxidation of rubber is a chain branching process. Binding together of the polymer chains of rubber in oxygen also has a chain character. In contrast to low-molecular weight hydrocarbons (1 heptene), radiation oxidation of rubber (SKB, SKD, SKI, SKN-26) proceeded with a high radiation yield (for SKN-26 G (addition of O_2) = 760 and G (peroxide) = 380). This is explained easily by the initiation of the primary and secondary oxidizing chains of rubber. (tr-auth)

33418 CALORIMETRIC OBSERVATION OF LOW-TEMPERATURE RADIATION POST-POLYMERIZATION IN THE SOLID PHASE. Gusakovskaya, I. G.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 46-53 (Jan.-Feb. 1968). (In Russian).

The polymerization and post-polymerization of acrylonitrile and vinyl acetate, irradiated with ^{60}Co γ rays at −196°C were investigated with a microcalorimeter. It was established that during slow melting of the irradiated acrylonitrile crystal specially grown at −196°C, post-polymerization (with polymer yield up to 6%) was observed in the vicinity of the phase transition at −113°C. An increase in the melting rate of the crystal was accompanied by an abrupt decrease of the polymer yield (to 0.1%). In the case of small-crystalline (fast-frozen) acrylonitrile polymerization during irradiation at −196°C was not observed. Post-polymerization proceeded in the vicinity of the phase transitions at −113, −135, and −167°C. Polymerization of vinyl acetate both in glass form and in the crystalline state during irradiation at −196°C was not observed, and post-polymerization of the vinyl glass was concentrated in the region of softening of the glass (from −160 to −135°C); the determined gravimetric yield of the polymer strongly depends on the melting rate and with decrease of the melting time to several seconds very insignificant quantities of the polymer (0.1%) are formed. (tr-auth)

33419 STUDY OF THE RADIOLYSIS OF IRON OXALATE BY MEANS OF GAMMA RESONANCE SPECTROSCOPY AND DERIVATIVOGRAPHY. Shkarin, A. V.; Suzdalev, I. P.; Kadenatsi, B. M.; Zhabrova, G. M. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 77-80(Jan.-Feb. 1968). (In Russian).

The radiolysis of $FeC_2O_4 \cdot 2H_2O$ and $Fe_2(C_2O_4)_3 \cdot 5H_2O$ was investigated by γ resonance spectroscopy, derivativography, and x-ray structure analysis. The γ dose of ^{60}Co was 1 to 5×10^8 RAD. It was established that preliminary irradiation does not affect the character of the dehydration and the thermal decomposition of the ferrous oxalate. Preliminary irradiation of ferric oxalate caused its reduction to ferrous oxalate, as well as the decrease of the activation energy and the pre-exponential multiplier of the phase transformation with maximum velocity at 200°C. Assumptions were made on the formation, during the irradiation of the iron oxalate hydrate, of mixed crystal lattices containing both the Fe^{3+} and Fe^{2+} cations. (tr-auth)

33420 ELECTRON SPECTRA OF RUBBER SUBJECTED TO THE EFFECTS OF γ IRRADIATION AT 77°K. Il'icheva, Z. F.; Slovokhotova, N. A. Khim. Vys. Energ., 2: 66-70(Jan.-Feb. 1968). (In Russian).

The electron spectra of cis-polyisoprene and cis-polybutadiene, subjected to the effects of ^{60}Co γ rays at 77°K, were investigated. In the spectra of irradiated polyisoprene, registered at 77°K without intermediate heating, an intense absorption band was observed with maximum at 250 to 260 mμ, and in the spectra of irradiated polybutadiene the absorption band had a maximum at 220 to 290 and 320 mμ, which disappeared during heating from 220 to 273°K. These bands were attributed to allyl, dienyl, and trienyl free radicals arising in the rubber during irradiation. The comparative quantity of these radicals depends on the structure of the rubber molecule. After heating of the irradiated rubber to 77°K, bands in the region 240 to 250 mμ, corresponding to coupled dienes, and the 274, 282, 294 mμ triplet, corresponding to the coupled trienes, appeared in their spectra. Reduction of the irradiation temperature of the rubber led to an increase in the yield of the coupled double bonds. (tr-auth)

33421 RADIATION-CHEMICAL CALORIMETER (ON THE USE OF CALORIMETRY IN RADIATION CHEMISTRY). Kritskaya, D. A.; Ponomarev, A. N.; Tal'roze, V. L. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 54-60(Jan.-Feb. 1968). (In Russian).

The possibility of the calorimetric detection of radical accumulation processes and molecular hydrogen break away reactions was demonstrated with a microcalorimeter (sensitivity 10^{-6} cal/sec) in the radiolysis of hydrocarbons irradiated with electrons at 2 keV. Evidence is given for the absence in the irradiated material of particles comparable to the free radicals in concentration and free energy. (tr-auth)

33422 THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF $[Co\ en_2F_2]NO_3$. Shagisultanova, G. A.; Orisheva, R. M. (Belorussian State Univ., Minsk). Khim. Vys. Energ., 2: 30-4(Jan.-Feb. 1968). (In Russian).

The dependence of the radiation yields of Co(II), NH_3, and CO_2 on the concentration of the original complex, total absorbed dose of γ radiation, and pH of the medium was investigated. It was found that under the same radiation conditions the behavior of the geometrically isomeric form of $[Co\ en_2F_2]NO_3$ is quantitatively different. The analogy in the character of the radiolytic and photolytic decomposition products was noted. On the basis of the regularities of the accumulation of the products in the irradiated solutions, the contribution of atomic hydrogen in the radiation decomposition of the complex salts was considered. (tr-auth)

33423 RADIOLYSIS OF WATER CONTAINING HYDROGEN PEROXIDE, HYDROGEN, AND OXYGEN. Kabakchi, S. A.; Shubin, V. N.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). Khim. Vys. Energ., 2: 40-5(Jan.-Feb. 1968). (In Russian).

The dependences of the radiation yields of hydrogen peroxide on the original concentrations of hydrogen peroxide and hydrogen in the $H_2O + H_2O_2 + H_2 + O_2$ system were studied. On the basis of data obtained previously a mechanism was proposed which quantitatively describes the experimental data for the system studied. Attempts were made to use the proposed mechanism for the description of the radiolysis of some other systems. (tr-auth)

33424 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF IRRADIATED FROZEN AQUEOUS SOLUTIONS. VIII. AQUEOUS SOLUTIONS OF CARBONATE AND BICARBONATE. Ershov, B. G.; Khodzhaev, O. F.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 35-9(Jan.-Feb. 1968). (In Russian).

The EPR spectra of aqueous solutions of K_2CO_3 and $KHCO_3$, irradiated with γ rays at −196°C, were studied. e^-_{bound} and the ion radical CO_3^- were identified and their radiation yields were measured. The optical absorption spectra of these particles were also studied. (tr-auth)

33425 RADIOLYSIS OF ACETONE. II. SOLID PHASE. Karasev, A. L.; Larin, V. A.; Bakh, N. A.; Veselovskaya, N. V.

(Inst. of Electrochemistry, Moscow). Khim. Vys. Energ., 2: 23-9(Jan.-Feb. 1968). (In Russian).

The stable final and initial products of the γ radiolysis of frozen acetone were identified. Methane, hydrogen, carbon monoxide, ethane, acetaldehyde, glacial acetic acid, methyl ethyl ketone, acetylacetone, isopropanol, and diacetyl were determined after irradiation at –196, –14, and –120°C by the gas-liquid chromatographic method. The radicals CH_3, CH_3CO, CH_3COCH_2, and the ion-radical $(CH_3COCH_3)^-$ were identified at –196°C by the EPR method. The formation of the final products observed was explained by the course of the reaction with parts of these radicals. The destruction of the first three radicals corresponds to their complete conversion into the observed products; the ion-radical is converted into isopropanol at only 20%. (tr-auth)

33426 RADIOLYSIS OF LIQUID AND SOLID NITROGEN TETROXIDE. Dmitriev, L. A.; Kamenetskaya, S. A.; Pshezhetskii, S. Ya. Khim. Vys. Energ., 2: 19-22(Jan.-Feb. 1968). (In Russian).

The radiation decomposition of liquid and solid N_2O_4 was studied in the interval from –196 to +45°C under the effects of γ radiation at dose outputs of 180 and 2200 rad/sec. It was established that the composition of the radiolysis products, O_2, N_2, N_2O, and N_2O_5, does not depend on the form of the condensed phase, the irradiation temperature, and the dose output. The effect of the aggregate state on the rate of the radiation decomposition of the condensed N_2O_4 was established: in the region of the fusion temperature (–11°C) a sharp increase was observed in the rate of decomposition of N_2O_4. The radiation yields for the formation of products and decomposition of N_2O_4 were calculated. The possible elementary processes, leading to the formation of the products, were examined. (tr-auth)

33427 RADIOLYSIS OF ETHYL IODIDE AND CARBON TETRACHLORIDE MIXTURES AT 77°K. Leblanc, R. M.; Thyrion, F. C.; Herman, J. A. (Laval Univ., Quebec). Can. J. Chem., 46: 1625-32(May 15, 1968).

The radical yields of $C_2H_5^{\cdot}$ and $CCl_3^{\cdot}$ observed by electron spin resonance of $CCl_4 + C_2H_5I$ mixtures irradiated by γ rays at 77°K are compared with yields of HCl, I_2, and HI measured after thawing. The dissociative capture of thermalized electrons by CCl_4 was extremely effective and accounts for most of the observed radicals. The difference between yields of HCl and $CCl_3^{\cdot}$ resulted from charge transfer from $C_2H_5I^+$ to $CCl_3^{\cdot}$. The formation of iodine proceeded both from neutralization processes of Cl^- ions with positive ions formed from C_2H_5I, and from ion–molecule reactions. (auth)

33428 REACTIONS OF HOT ^{38}Cl ATOMS IN MIXTURES OF CARBON TETRACHLORIDE WITH AROMATIC COMPOUNDS. Berei, K.; Vasaros, L. (Zentralforschungsinstitut fuer Physik, Budapest). Isotopenpraxis, 4: 19-23(Jan. 1968). (In German).

Chemical consequences of the $^{37}Cl(n,\gamma)^{38}Cl$ reaction were investigated in mixtures of carbon tetrachloride with aromatic compounds in order to obtain specific information on the behavior of recoil ^{38}Cl. The radiochemical yield was determined for each of the products from the systems CCl_4–benzene and CCl_4–chlorobenzene in both the liquid and solid phases and at various relative concentrations. The concentration and phase dependence could be established for the individual yields in ^{38}Cl labeled carbon tetrachloride, chlorobenzene, chloroform, and tetrachloroethylene as well as for the distribution of the ortho-, meta-, and para-isomers of the dichlorobenzene yield. (auth)

33429 DEPENDENCE OF THE ACTIVITY YIELD AND THE SPECIFIC ACTIVITY ON THE IRRADIATION TIME BY SZILARD–CHALMERS PROCESSES: METAL PHTHALOCYANINES. Grossmann, G.; Muehl, P.; Grosse-Ruyken, H.; Knoefel, S. (Technische Univ., Dresden. Institut fuer Metallphysik und Reinstmetalle, Dresden). Isotopenpraxis, 4: 23-8(Jan. 1968). (In German).

The differential equations for the time dependence of the activity yield for Szilard–Chalmers reactions given by Matsuura were extended taking into account radioactive decay during irradiation. In the calculation of the specific activity chemical decomposition during separation of the irradiated targets was also included. More extensive differential equations are given in the case of strong irradiation decomposition. The dependence of the activity yield, the specific activity, and the decomposition rate on the irradiation time was calculated with an analog computer for diverse models. The constants for the decomposition and recombination were evaluated from experimental results by irradiation of several metal phthalocyanines. With these constants the calculated curves agree satisfactorily with the experimental values given in the literature or resulting from current measurements. (auth)

33430 TECHNICAL ASPECTS OF RADIOCHEMICAL PROCESSES. Wuckel, Lothar (Institut fuer Metallphysik und Reinstmetalle, Dresden). Chem. Tech. (Leipzig), 20: 1-11(Jan. 1968). (In German).

The international status and aspects of technical radiochemistry are considered. Various radiation sources are described, and a discussion of the relative merits of radionuclides and accelerators is given. Typical chemical processes of interest for development as radiochemical synthetics include: first, products of reactions with low G values, such as hydrazine, nitrogen dioxide, carbon suboxide, glycol, crosslinked plastics, and vulcanized materials, and second, products of reactions with high G values, such as ethyl bromide, sulfochlorinated compounds, sulfonic acids, some oxidation products, polymerizations, and copolymerizations. Suggestions for further development are made. (BBB)

33431 IONIZING IRRADIATION EFFECTS ON THE FRACTURE SURFACE ENERGY OF POTASSIUM CHLORIDE. Bhattacharya, Tapan Kumar. Chicago, Illinois Inst. of Tech., 1966. 94p.

Thesis.

The effects of ^{60}Co gamma- and 40-KV x-irradiation on the fracture surface energy and external surface energy of potassium chloride single crystals were investigated. The fracture surface energy was measured by the Obreimov–Gilman slow-cleavage technique using the experimental procedure described by Westwood and Hitch. Gamma-irradiation at room temperature caused a decrease in the fracture energy at 300°K and an increase at 115°K. The effects of room-temperature "F-light" bleaching on the fracture energy of gamma-irradiated KCl showed that the formation of aggregate centers causes an increase in the fracture energy and that the increase is larger when the measurement is done at 115°K. The effect is reversed when the aggregate centers are destroyed by re-irradiation. A theory is developed to account for the observed radioinduced changes in fracture energy. The fracture energy ϕ of gamma-irradiated KCl at 300°K and 115°K follows the equation: $\phi = \phi_0 + a_1 D_F^{1/2} + a_2 D_F^{2/3}$, where ϕ_0 is the fracture energy of the unirradiated crystal, D_F is the F-band optical density per centimeter, and a_1 and a_2 are constants independent of D_F. The square-root term represents a plastic-flow contribution, which decreases with increasing irradiation and is dominant at room temperature. The two-thirds power term represents an extrinsic, point defect (EPD) contribution, which increases with increasing irradiation and is dominant at the lower temperature. The decrease in the plastic-flow contribution with a decrease in temperature is consistent with the known increase of brittleness. The occurrence of an EPD contribution is a consequence of radio induced lattice distortion, which results in mismatch between the neighboring lattice planes. The formation of aggregate centers increases such mismatch and hence the EPD contribution, the effect being reversed with the destruction of the aggregate centers by re-irradiation. The external surface energy of gamma- and 40-KV x-irradiated KCl crystals was measured at 300°K by a precision pendulum sclerometer based on the methods of Kuznetsov. The external surface energy first decreases, attains a minimum, and then increases with increasing irradiation for both gamma- and x-irradiation. The x-induced changes are much larger compared to those for gamma. The radioinduced changes in external surface energy are explained by assuming a quasistatic friction mechanism, with the result that the external surface energy follows a relation similar to that derived for the fracture energy. Spontaneous and artificial crack healing in unirradiated and irradiated KCl was studied also. Qualitative observations on crack healing lend support to the above findings. (Disser. Abstr.)

33432 ELECTRON SPIN RESONANCE STUDIES OF RADIATION DAMAGE. PART II. GAMMA-IRRADIATED SINGLE CRYSTALS OF SODIUM CHLORATE: THE ClO_3 RADICAL. Patrick, P. F.; Sargent, F. P. (Univ. of Saskatchewan, Saskatoon). Can. J. Chem., 46: 1818-19(May 15, 1968).

Single crystals of sodium chlorate were gamma-irradiated and examined by ESR at –196°C. One of the species present was identified as ClO_3. (auth) (Canada)

33433 ELECTRON SPIN RESONANCE EVIDENCE FOR A TRAPPED ELECTRON AND ITS REVERSIBLE REACTION IN GAMMA IRRADIATED ACETONITRILE-d_3. Bonin, M. A.; Tsuji, K.; Williams, F. (Univ. of Tennessee, Knoxville). Nature (London), 218: 946-8(June 8, 1968).

Electron stabilization in glasses and crystals was studied in organic nitriles since the large permanent dipole moment and high degree of polarisability conferred by the nitrile group might be of advantage in this connection. ESR and optical evidence was obtained for trapped electrons in several gamma-irradiated crystalline nitriles. The studies described are concerned primarily with acetonitrile-d_3, for which the ESR observations were extremely clear, whilst the reversibility of the photobleaching reaction in this system is also of considerable interest. The ESR spectrum of gamma irradiated CD_3CN is shown, the most prominent component consisting of a quintet with a splitting of 16.6 gauss; no spectrum corresponding to CD_3 radicals could be seen. Before this spectrum was taken the sample had been left in the dark at 77°K during and after irradiation. The photo-bleaching action was also studied between 77 and 115°K, and ESR spectra which accompanied changes at 89°K are shown. On photo-bleaching the sample with red light in the ESR cavity the quintet spectrum disappeared at 89°K and a septet spectrum with a splitting of 3.3 gauss appeared, tentatively assigned to the CD_3 radical. After switching off the light the septet spectrum disappeared and complete recovery of the original quintet spectrum occurred within a few minutes. Kinetic studies at 89°K verified that the decay of the quintet spectrum and appearance of the septet spectrum during the onset of photo-bleaching were both described by the same first order rate constant, as would be expected for a simple unimolecular transformation. At 77°K thermal recovery after photo-bleaching required more than 20 hr. for completion. It is proposed that the quintet spectrum arose from a trapped electron interacting with two equivalent nitrogen nuclei. It is considered remarkable that the photodissociation can be reversed by thermal means, since the reaction involves repair of a broken bond and simultaneous electron transfer. A further requirement is that the CD_3 radical must remain translationally inmobile in the crystalline matrix. The electron is trapped in a crystalline matrix and is bonded specifically to the N-atoms of two CD_3CN molecules. It is probable that the hyperfine interaction arises largely from spin polarization of the 2s electrons in nitrogen rather than from a small amount of s-character in the bonding orbital of the unpaired electron itself. Some studies are also reported on CH_3CN and succinonitrile. (A note added in proof suggests that the species produced on photo-bleaching may be $[CD_3CN]^-$ rather than CD_3.) (UK)

33434 RADIATION-INDUCED REACTIONS WITH CELLULOSE. V. MECHANISM STUDIES OF COPOLYMERIZATION WITH STYRENE IN NON-WETTING SOLVENTS. Dilli, S.; Garnett, J. L. (Univ. of New South Wales, Kensington, Australia). Aust. J. Chem., 21: 397-407(Feb. 1968).

Radioinduced grafting to cellulose, using the nonwetting solvents benzene, cyclohexane, hexane, ethyl acetate, and n-butanol, n-hexanol, and n-octanol, was studied using irradiations in both air and vacuum from ^{60}Co and spent-fuel element facilities over ranges in total dose from 0.2 to 10 Mrad at dose rates of 0.077 to 1.40 Mrad/hr. Radioinduced grafting of the monomers styrene, methyl methacrylate, vinyl acetate, and 2- and 4-vinylpyridine to cellulose generally gave poor grafting yields irrespective of the variables such as dose rate, total dose, and monomer concentration. Under certain conditions, an oxygen effect on the grafting reactions was observed. The results were interpreted in terms of possible radical-scavenging reactions, in particular, a charge-transfer theory, and the limited access of the monomer in these solvents to the active sites within the trunk polymer. The inclusion of small amounts of methanol in the solvent was shown to enhance the grafting yields. This was attributed to the enhanced swelling of cellulose by methanol, permitting easier access of the monomer molecules to the reactive sites in the backbone polymer. In solvents such as benzene, this same degree of swelling is absent and this reason, presumably, accounts for the marked difference in radiation yields. (BBB)

33435 RADIOINDUCED POLYMERIZATION OF ETHYLENESULFONIC ACID. Yamakita, Hiromi; Fujii, Shigetada (Government Industrial Research Inst., Nagoya, Japan). Kogyo Kagaku Zasshi, 71: 430-2(Mar. 1968). (In Japanese).

Polymerization of ethylenesulfonic acid by γ irradiation was studied by a dilatometric method. The G(-M)-values for the bulk polymerization over the temperature range of −30 to 70°C were found to be 110,000 to 240,000, while the G_R-values were 3 to 5. The conversions of the bulk polymerization at 70°C and 45°C were lower than that at 0°C except in the initial period. This temperature dependence seems to be due to the retarding effect of the irradiation product formed at high temperatures. The rate of polymerization in dilute aqueous solutions was proportional to 1.3 power of the monomer concentration and this fact can be explained by assuming that the primary radicals participate in the termination reaction. The rate of polymerization, however, reached a maximum at a certain monomer concentration between 80 and 100%, and this fact seems to be due to the acceleration effect by the dissociation of the monomer in water. The G(-M)-value for the polymerization in 88.1% aqueous solution was 390,000. (NSA of Japan)

33436 ELECTRON-DIFFRACTION INVESTIGATION OF THE HEXAFLUORIDES OF TUNGSTEN, OSMIUM, IRIDIUM, URANIUM, NEPTUNIUM, AND PLUTONIUM. Kimura, Masao (California Inst. of Tech., Pasadena); Schomaker, Verner; Smith, Darwin W.; Weinstock, Bernard. J. Chem. Phys., 48: 4001-12(May 1, 1968).

An electron-diffraction investigation was made by the sector–microphotometer method on WF_6, OsF_6, IrF_6, UF_6, NpF_6, and PuF_6. The photographs of all these compounds reflect a phase shift which if not accounted for leads to asymmetric structures for the molecules. It sets in at smaller values of $s = 4\pi\lambda^{-1} \sin (\partial/2)$ the heavier the molecule and the greater the electron wavelength. There is good evidence for the symmetrical octahedral structure of all the compounds. The metal-fluorine distances were found to be 1.833 Å (W−F), 1.831 Å (Os−F), 1.830 Å (Ir−F), 1.996 Å (U−F), 1.981 Å (Np−F), and 1.971 Å (Pu−F), with estimated limits of error of ±0.008 Å except for ± 0.010 Å for Pu−F. (auth)

33437 MECHANISM OF HYDROGEN FORMATION IN THE RADIOLYSIS OF n-PENTANE. Horowitz, A.; Rajbenbach, L. A. (Soreq Nuclear Research Centre, Yavne, Israel). J. Chem. Phys., 48: 4278-83(May 1, 1968).

The radiolytic yields of trichloroethylene, hydrogen, and hydrogen chloride from solutions of tetrachloroethylene in n-pentane were determined. A mechanism for radiolytic hydrogen formation, which assumes the existence of three precursors of hydrogen, is postulated. The initially formed excited species C_5H_{12}' is assumed to yield thermal hydrogen atoms. This species is scavenged at low tetrachloroethylene concentrations. Molecular (unscavengeable) hydrogen is assumed to be formed from the decomposition of another excited species, C_5H_{12}'', a process which is not affected by the presence of tetrachloroethylene. Hot hydrogen atoms are assumed to be formed mainly from charge recombination reactions. The reduction in hydrogen yield at concentrations above $10^{-2}M$ tetrachloroethylene is due predominantly to electron scavenging by the solute. Kinetic treatment of the results gives the following G values for the hydrogen yield resulting from the decomposition of C_5H_{12}' and C_5H_{12}'' and from charge recombination reactions: G(H) thermal = 1.0; $G(H_2)$ molecular = 1.6; $G(H_2)$ electronic = 2.3. (auth)

33438 RADIOLYSIS OF METHYLCYCLOPENTANE. I. NONHOMOGENEOUS KINETICS OF CHARGE SCAVENGING IN THE LIQUID PHASE. Stover, E. Diane; Freeman, Gordon R. (Univ. of Alberta, Edmonton). J. Chem. Phys., 48: 3902-5(May 1, 1968).

Methylcyclopentane (MCP) was irradiated in the presence of a number of solutes. The hydrogen yield from pure MCP, $G(H_2) = 4.2$, was decreased to 2.2 by the addition of N_2O or SF_6, whereas the addition of ND_3 increased the total hydrogen yield above the value in pure MCP. In the ND_3 solutions the yield of HD was twice the decrease in H_2 yield, so not all positive ions formed in the absence of ND_3 lead to H_2 formation. In pure MCP, PH^+ leads to hydrogen formation and QH^+ does not. Both types of positive ions react with ammonia by proton transfer: $G(PH^+) = 2.0$ and $G(QH^+) \approx 1.2$. By using a nonhomogeneous kinetics model of charge scavenging, it was determined that electrons are an order of magnitude more readily scavengeable than are positive ions in the radiolysis of methylcyclopentane. Determination of the value of the kinetics parameter β in various radiolysis scavenging systems will help to determine the nature of the scavenging reactions that occur in them. (auth)

33439 RADIOLYSIS OF LIQUID n-PENTANE: PRODUCTS AND MECHANISM. Bishop, William Peter. Columbus, Ohio, Ohio State Univ., 1967. 165p.

Thesis.

All the major products of the radiolysis of liquid n-pentane at 25°C were identified, and 100-eV yields were determined for each. All products of significant yield were found to have 100-eV yields independent of dose over the range of 7×10^{19} to 25×10^{19} eV/gm total dose (~0.2% conversion). The curves for total yield per gram vs dose extrapolated to zero yield at zero dose for all hydrocarbon products. Reduction of temperature to −78°C caused a decrease in the decomposition of pentane of about one third. This was attributed to the inhibition of abstraction reactions at the low temperature. The effects of various concentrations of iodine additive were also studied at 25°C. Reduction of alkane and alkene yields with concomitant appearance of stable iodides indicated that free radicals and atomic species are of major importance in the radiolysis process. Evidence was also seen for electron scavenging by iodine at very low concentrations (<1 mM.). Various radical intermediates are discussed, including all radicals possible from simple bond scission plus those with secondary structure and alkenyl radicals. Ionic species and excited species appear to play a minor role in the overall decomposition, but may be responsible for certain products and intermediates. From the 100-eV yields from the decomposition of pentane, contributions of various processes were calculated to be: unscavengeable processes, 15%; H abstraction from pentane, 37%; and other radical-forming processes, 48%. (Disser. Abstr.)

33440 KINETICS OF IONIC PROCESSES IN THE RADIOLYSIS OF LIQUIDS. IV. GEMINATE RECOMBINATION OF IONS. Williams, Ffrancon (Univ. of Tennessee, Knoxville). Contract AT(40-1)-2968. J. Chem. Phys., 48: 4077-8(May 1, 1968). (ORO-2968-28).

An estimate is made of the dispersion in the recombination time for ions undergoing diffusive recombination from an initial separation distance. Then, an elementary method is used to obtain the least distance of ionic approach for which the Nernst-Einstein relation describes the motion of the ions. The inclusion of these considerations does not seriously affect the dependence of recombination time on r^3 for r values between 40 and 120 Å in liquids of low dielectric constant ($\epsilon \approx 2$) at 300°K. (auth)

33441 RADIATION-CHEMICAL ANILINE PRODUCTION. Seliga, M. (Komensky Univ., Bratislava). Collect. Czech. Chem. Commun., 33: 999-1003(Mar. 1968). (In German).

The effects of ^{60}Co γ radiation on a mixture of benzene and gaseous ammonia at various mole ratios and with various admixtures was investigated. In the radiolysis of mixtures of benzene and ammonia an aniline yield of ~0.5 molecule/100 eV was obtained at 20°. Linear concentration dependence of the aniline yield on the time is illustrated. Admixtures of argon, oxygen, carbon disulfide, and halogen derivatives of benzene sensitized the reaction. The dependence of the aniline yield on the benzene/bromobenzene ratio is discussed. (J.S.R.)

33442 γ IRRADIATION OF THYMINE DIMERS IN AQUEOUS SOLUTION. Deering, R. A.; Snipes, Wallace (Pennsylvania State Univ., University Park). Biophys. J., 8: 326-36(Mar. 1968).

Thymine dimers were irradiated in aqueous solution with ^{60}Co γ rays in N_2 or O_2. Thymine and unidentified non-uv-absorbing products appeared. The thymine was identified by spectrophotometry chromatography, and ability to support the growth of Escherichia coli 15 T^-. Residual dimer was determined by a uv-reversibility assay. The G values for dimer breakage were ~ equal in N_2 and O_2. At low γ doses, about 2 thymines were produced per dimer broken in N_2, whereas only about 1 thymine appeared per dimer broken in O_2. For dimer irradiated in frozen solution, the yield of thymine was at least 100 times less than in liquid. (BBB)

33443 NATURE OF ISOMERIC-TRANSITION-INDUCED ^{82}Br REACTIONS WITH CH_4 AND CD_4. Nicholas, J. Blair; Rack, Edward P. (Univ. of Nebraska, Lincoln). Contract AT(11-1)-1617. J. Chem. Phys., 48: 4085-92(May 1, 1968). (COO-1617-9).

The role of excess kinetic energy and thermal processes in the ^{82}Br reaction in gaseous CH_4 and CD_4 activated by ^{82m}Br isomeric transition (IT) was determined using rare gas and bromine additives. Possible isotope effects were investigated between (n,γ)-induced ^{80}Br and ^{80m}Br and between CH_4 and CD_4 target molecules. The "freeze-thaw" technique and (n,γ) "in-reactor" technique were employed in determining the ^{82}Br organic yields. The effects of He, Kr, Xe, and Br_2 additives on the reaction of CH_4 and CD_4 with ^{82}Br activated by the (IT) process are presented. The data appear to extrapolate, at zero mole fraction CH_4, to 3.7% ± 0.5% for the He, Kr, and Xe additives and to 0% for Br_2. This would indicate that 7.4% minus 3.7% is formed via excess kinetic-energy processes and that 3.7% of the organic ^{82}Br is formed via thermal (kinetic-energy-independent) processes, probably involving Br^+ ions in their first two excited states, $^3P_1$ and $^3P_0$. The data suggest the absence of a target molecule isotope effect between CH_4 and CD_4 in the ^{82}Br (IT)-activated process, but do suggest a target molecule isotope effect for (n,γ)-activated bromine reactions. The data for bromine reactions involving excess kinetic energy were analyzed using the kinetic theory of hot reactions. The reactivity integral values I were found to be very low. The kinetic theory showed good internal consistency for (IT)-activated bromine reactions. Experimental data showed the absence of any isotope effect between (n,γ)-induced ^{80m}Br and ^{80}Br reaction in CH_4. The use of HBr as a source molecule was reinvestigated in the CD_4 system and found to give organic yields higher than those of Br_2 systems at low mole fractions. This difference diminished at higher HBr concentrations. (auth)

33444 INFLUENCES OF MONOMER CONCENTRATION, PREIRRADIATION DOSAGE AND PACKING DENSITY OF FIBER ON THE REACTION RATE OF EMULSION GRAFTING OF STYRENE ONTO PRE-IRRADIATED RAYON. Kageyama, Eiichi; Nozaki, Fumio (Japan Atomic Energy Research Inst., Tokyo). Kogyo Kagaku Zasshi, 71: 583-7(Apr. 1968). (In Japanese).

Influences of monomer concentration, preirradiation dosage, and packing density of the fiber on the grafting rate of styrene onto rayon were investigated. In the case where the packing condition of fiber was not too dense, the monomer concentration had little effect on the grafting rate. Both the grafting rates, the rapid one in the initial period and the slow in the second period showed a linear increase with increasing preirradiation dosage. The influence of packing density of fiber on the grafting rate was so complicated that no definite conclusion could be made. However, it can be said that in the case of a 10 vol % styrene emulsion, mass transfer of styrene from monomer droplets to fiber has no effect on the grafting rate under appropriate conditions in which the variation of $A \cdot \rho_f$ does not exceed 60 (Mrad kg/m^3). On the other hand, the grafting rate is lowered under the influence of mass transfer above the $A \cdot \rho_f$ range of 60 (A denotes the preirradiation dosage in Mrad and ρ_f, the packing density of fiber in kg/m^3). (NSA of Japan)

33445 CORRELATION BETWEEN GRAFTING RATE AND SWELLING DEGREE OF FIBER IN A LIQUID-PHASE GRAFT POLYMERIZATION OF STYRENE ONTO PREIRRADIATED POLYNOSIC RAYON. Kageyama, Eiichi; Nozaki, Fumio (Japan Atomic Energy Research Inst., Tokyo). Kogyo Kagaku Zasshi, 71: 580-2(Apr. 1968). (In Japanese).

The grafting rate of styrene onto a polynosic rayon, irradiated by electron beams, was measured to investigate a relationship between the degree of swelling of the fiber and the grafting rate. In the presence of a large amount of water, the grafting proceeds via two steps, a rapid initial stage and a slow second stage. When only a little amount of water is included, however, the grafting shows a low rate throughout the reaction period. The swelling of the fiber does not depend on the absolute amount of water in the liquid phase, but varies linearly over a wide range with an increase of water concentration. The initial rate of grafting shows a linear increase with increasing degree of fiber swelling. On the other hand, the grafting rate obtained in the second stage is independent of the swelling of the fiber. (NSA of Japan)

33446 RADIATION-INDUCED TRANSFORMATION OF AMORPHOUS TO CRYSTALLINE SOLIDS. Cox, Carl Matthew Jr. Charlottesville, Va., Univ. of Virginia, 1967. 245p.

Thesis.

The radioinduced crystallization of amorphous films of Ta_2O_5 and Ge at controlled temperatures and atmospheres in the core of the University of Virginia Reactor is described. It was found by transmission electron microscopy that these amorphous films transform to the crystalline phase upon fast neutron irradiation in the 10^{16} to 10^{17} $nvt_{>1MeV}$ range at temperatures 100 to 200°C below the temperatures at which similar effects could be obtained thermally. The phenomenon is strongly temperature dependent, and a 25°C difference in irradiation temperature makes a significant difference in the degree of crystallization. The density of radioinduced crystallites was found to be proportional to the fast neutron exposure. Evidence for preferential nucleation in the displacement cascade regions was obtained from post-irradiation annealing of Ge specimens which had been irradiated at too low a temperature to crystallize during irradiation, and which exhibited a decreased activation energy for crystallization during subsequent anneals. On the other hand, a different specimen, which had been irradiated at too low a temperature (~50°C) for preferential nucleation to be effective during irradiation, exhibited a high concentration of crystallites proportional to the fast neutron exposure, suggesting the action of a thermal spike. The differences in behavior are apparently due to differences in the "structure" of the evaporated films because of different evaporation rates. The data from the latter irradiation experiments were analyzed from both a collision cascade and a thermodynamic viewpoint. In the former analysis the neutron energy spectrum was taken from a 68 energy group diffusion code and ratioed to absolute fluxes based on threshold foil measurements. Anisotropic scattering in the center of mass coordinate system was accounted for by using the angular dependence of the Zn(n,n) reaction. Neglect of this anisotropy would lead to significant errors, as would assumption of fission neutron spectrum. The sizes of the cascade regions were approximated by the ranges of the primary knock-ons, and the latter were calculated using the energy dependent hard sphere model, including ionization energy losses and choosing the screening parameter so that the predicted nuclear stopping power is close to that given by a published Monte Carlo calculation which is based on a Thomas-Fermi potential. Comparing the calculated range spectrum of Ge primary knock-ons with the experimentally observed size spectrum of crystallites, it was found that while the density of primary knock-ons increased continuously with decreasing energy and range, the density of crystallites first increased as their size decreased, following the range spectrum of primary knock-ons, and then went through a maximum, decreasing rapidly for smaller sizes. It is expected that insufficient energy was distributed in the lower energy cascades to form stable nuclei. Above this critical energy, the sizes of radioinduced crystallites are approximately proportional to the ranges of the primary knock-ons. The temperature and "structure'' dependence of fast neutron induced crystallization of amorphous Ge is consistent with a rate process model which includes a thermal spike and takes into account preferential nucleation in the cascade regions. This model predicts that in a case where the necessary activation energy for crystallization $\gtrsim$1.5 ev/atom and the irradiation temperature is $\lesssim$50°C, more nuclei could be produced by thermal spikes than by preferential nucleation in the cascade regions; however, as the irradiation temperature is increased or the activation energy decreased, the relative worth of the thermal spike in inducing crystallization is predicted to become very small. (Disser. Abstr.)

33447 RADICAL-INITIATED CHAIN DEHALOGENATION OF ALKYL HALIDES IN ALKALINE ALCOHOLIC SOLUTION. **Sherman, Warren V. (Univ. of Notre Dame, Ind.). J. Phys. Chem., 72: 2287-8(June 1968).**

Radical-initiated chain dehalogenation of methyl bromide and methyl iodide in alkaline methanol and 2-propanol was observed on exposure to ^{60}Co γ rays. The yield of the observed chain product, methane, from these solutions exceeded values that might be expected on the basis of nonchain scavenging of radiolytic intermediates by halide in these systems. Methane yields from solutions initially containing 10^{-2} $\underline{M}$ methyl halide are tabulated. It was noted that higher yields were observed in the 2-propanol solutions. (P.C.H.)

33448 THERMAL DECOMPOSITION OF LITHIUM AZIDE. **Prout, E. G.; Liddiard, V. C. (Univ. of Cape Town). J. Phys. Chem., 72: 2281-3(June 1968).**

Studies were made on the thermal decomposition of preirradiated and unirradiated lithium azide. The decomposition was greatly altered by preirradiation with γ rays (^{60}Co) or uv light at room temperature. The induction period was shortened (with a γ-ray dose of 15,000 rads it was eliminated), and the acceleration of the reaction was increased. The activation energies for the decomposition of irradiated and unirradiated LiN_3 are tabulated. A study of the effects of a brief exposure of the preirradiated (γ rays and uv light) salt to water vapor prior to decomposition showed that the accelerating effect was destroyed. Similar preexposure of the unirradiated salt did not alter the subsequent decomposition. It was concluded that the effect of irradiation is to increase the number of nuclei that develop on heating, although the effect of water vapor indicated that the initiating species in the creation of a nucleus is different for the irradiated salt. (P.C.H.)

33449 RATE OF HYDROGEN DIFFUSION IN ROOM-TEMPERATURE IRRADIATED QUARTZ. **Garland, John K.; Schroeder, John W. (Univ. of Missouri, Columbia). J. Phys. Chem., 72: 2277-8(June 1968).**

An estimation was made on the rate of hydrogen diffusion at room temperature in quartz subjected to the neutron-irradiation conditions required for recoil tritium experiments. This rate was compared to the rate predicted by extrapolation of high-temperature data. The results showed that hydrogen diffusion in room-temperature irradiated quartz is much faster than predictions based on nonirradiated quartz and that it can be a significant problem, even in condensed-phase recoil tritium experiments where recoil loss is low. (P.C.H.)

33450 RADIATION CHEMISTRY OF ACETAMIDE. **Rao, K. Narayana; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 72: 2181-5(June 1968).**

The two crystalline forms of acetamide gave quite different product yields under γ rays. In particular, acetonitrile, the major product from the thermodynamically stable form, was produced in much smaller yield from the labile form. Doses of several megarads produced some change in the labile form that resulted in a large decrease in hydrogen yield. Liquid acetamide gave smaller nitrile yields and much larger yields of gaseous products than either solid form. (auth)

33451 DECOMPOSITION OF AQUEOUS PERCHLORATES BY RADIATION. **Katakis, D.; Konstantatos, J. (Democritos Nuclear Research Center, Athens). J. Phys. Chem., 72: 2054-7 (June 1968).**

The investigation of the radiation chemistry of aqueous concentrated perchlorate ion solutions was extended into the alkaline region, where the G-values of chlorate, chlorite, and some of the H_2O primary products, at various $NaClO_4$ concentrations, were determined. The G-values of the primary products were calculated from data obtained with solutions containing ferricyanide, ferricyanide + CH_3OH, and ferrocyanide + N_2O. It was concluded that, for a given ClO_4^- concentration, $G(-ClO_4^-)$ remains the same over a wide range of hydrogen ion concentrations. A brief comparison was also made among H^+, Na^+, Zn^{2+}, and La^{3+} in relation to their role in the radiolysis of the perchlorate-water mixtures. (auth)

33452 PULSE RADIOLYSIS OF AQUEOUS FLUORESCEIN. **Cordier, P.; Grossweiner, L. I. (Michael Reese Hospital and Medical Center, Chicago). J. Phys. Chem., 72: 2018-26(June 1968).**

A pulse-radiolysis investigation of aqueous fluorescein has shown that the initial reaction products are the semiquinone from the reduction of the dye by e_{aq}^- and H atoms, the semioxidized radical from the attack of OH, and a long-lived ''red product'' attributed to OH and H atom adducts. Rate-constant measurements are reported for the dye-radical formation and decay reactions, based on analog computer analysis. Other new results obtained include the formation of an unstable complex between the semiquinone and the dye which leads to long semiquinone lifetime at high initial dye concentrations and decay of the OH adduct by water elimination to form the semioxidized radical species. The pulse-radiolysis mechanism is in general agreement with cobalt-60 irradiation results. (auth)

33453 EFFECT OF RADIATION ON THE REACTIONS OF RECOIL ^{11}C IN THE NITROGEN-OXYGEN SYSTEM. **Ache, Hans J.; Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 72: 1988-93(June 1968).**

Highly energetic carbon-11 atoms were produced in nitrogen-oxygen gas mixtures using either the 10-MeV proton beam of the Brookhaven National Laboratory 60-in. cyclotron for the $^{14}N(p,\alpha)^{11}C$ reaction or the 3-GeV proton beam of the Brookhaven National Laboratory cosmotron for the $^{14}N(p,2p2n)^{11}C$ reaction. The primary products in their reactions with nitrogen and oxygen are ^{11}CN and ^{11}CO, respectively. The oxidation of these two products was studied as a function of the radiation energy dissipated by the proton beam in the system. It was found that ^{11}CN was mostly oxidized to $^{11}CO_2$. The oxidation of ^{11}CO to $^{11}CO_2$ under these experimental conditions was found to be approximately a linear function of the radiation dose. The conversion decreased (at constant radiation dose) with the dose rate. (auth)

33454 PROBLEMS OF RADIATION CHEMISTRY OF POLYPROPYLENE. **Veselovskii, R. A.; Leshchenko, S. S.; Karpov, V. L. (Karpov Inst. of Physics and Chemistry, USSR). Vysokomol. Soedin., Ser. A, 10: 760-70(Apr. 1968). (In Russian).**

The mechanism of radiolysis of polypropylene depends on its molecular weight, content of oxygen, and segmental mobility of polymer chains. In different samples the relative role of these factors varies which probably accounts for big scatter of radiation chemical parameters given by different authors. Radiation crosslinking of isotactic PP proceeds mainly through double bonds of vinylidene type, crosslinking of amorphous polypropylene through mainly free radicals. (auth)

33455 THE MECHANISM AND THE PRODUCTS OF THE RADIOLYSIS OF α-METHYL-D-GLUCOSIDE. Kochetkov, N. K.; Kudryashov, L. I.; Chlenov, M. A.; Chizhov, O. S. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 179: 1385-8(Apr. 21, 1968). (In Russian).

It had been established earlier that the main product of the radiolysis of aqueous solutions of α-methyl-D-glucoside is 5-deoxy-4-ketohexose, formed by the disproportionation of the primary radicals resulting from the radiolysis. For further study, the so-called product B was subjected to further analysis. Earlier results indicated that this compound corresponds to α-methyl-5-deoxy-6-al-glucofuranoside, with an acetylated aldehyde group. Reduction of the compound yielded complex products; therefore, one of the derivatives, 4-keto-5-deoxyhexose acetate was subjected to mass-spectroscopic analysis. The data confirmed the above assumed structure for Product B. Its molecular weight was calculated as 190; it was also found that the product contains one hydroxyl and 2 methoxy groups. The compound itself, its acetate and glucoside contain molecules with bicyclic groups formed by two joint furanose rings. The data confirmed the earlier assumptions concerning the mechanisms of the radiolysis; but left open the question of the nature of the compound formed during the disproportionation together with the deoxy-keto-sugars. (TTT)

33456 ELECTRON PARAMAGNETIC RESONANCE STUDY OF THE FREE-RADICAL STATE, FORMED ON IRRADIATION OF FROZEN SOLUTIONS OF CELLOBIOSE, GENTIOBIOSE, AND MALTOSE. **Emanuel, N. M.; Sharpatyi, V. A.; Nadzhimiddinova, M. T.; Kudryashov, L. I.; Yarovaya, S. M.; Kochetkov, N. K. (Inst. of Organic Chemistry, Moscow. Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR, 177: 1142-5(Dec. 11, 1967). (In Russian).**

The role of free radicals in the radiolytic changes of 3.03 to 10^{-1} $\underline{M}$, chromatographically pure, chilled and frozen solutions of disaccharides was investigated by spectrographic examination of the EPR of these simplest fragments of natural polysaccharides. The EPR spectra of cellobiose, gentiobiose, and maltose were interpreted as the result of the superimposition of the absorption lines of several radicals. The three spectra were found to be quite similar, differing only in the resolution of their hyperfine structure. The results indicated that the spectra and the radicals change at specific temperatures of temperature ranges: −170, −150 to −140, −120 to −110, −70 to −60, and −40°C. These changes are due to the rearrangement of the radicals and changes in the conditions of their stabilization in the matrix. Redistribution of the absorbed energy between the components of the system, i.e., the mechanism of the radiolysis is affected also by the structure of the matrix. It was found that even when the radiolysis occurs at low temperatures, decomposition of the dissolved material is due primarily to the free radicals formed from water. (TTT)

33457 STUDY OF SENSITIZATION OF RADIATION-CHEMICAL PROCESSES IN RUBBERS. Kozlov, V. T.; Kaplunov, M. Ya.; Tarasova, Z. N.; Dogadkin, B. A. (Scientific-Research Inst. of the Fire Industry, Moscow). Vysokomol. Soedin., Ser. A, 10: 987-94(May 1968). (In Russian).

Radiation crosslinking of rubbers is sensitized by addition of halogenated alkanes. The effect is increased with smaller alkane molecules and higher degree of halogenation. Considerable amounts of stabilized electrons were detected in low-temperature radiolysis of hexachloroethane by means of ESR. Electron acceptors such as chlorides of polyvalent metals, DPPH, etc., sensitize radiation crosslinking of rubbers. Therefore the sensitizing effect with halogencontaining compounds is mainly related to their ability to electron capture. (auth)

33458 METHOD FOR PRODUCING HYDROCARBONS. Okada, Yoichi. Japanese Patent 1967-23002. Nov. 9, 1967. Filed Mar. 21, 1964.

A method is proposed for producing saturated or unsaturated aliphatic hydrocarbons with carbon numbers of integral multiples of those of the saturated aliphatic hydrocarbons. The method is effective and direct, with a high yield and with no side reactions. A saturated aliphatic hydrocarbon in the liquid phase is irradiated with ionizing radiation or ultraviolet rays in the presence of dinitrogen monoxide. (NSA of Japan)

33459 SOLVATED ELECTRON. Dye, James L. Sci. Amer., 216: 77-84(Feb. 1967). (COO-958-10).

Production of solvated electrons and their reactions with each other are reviewed. Solvated electrons produced by radiolysis of solutions are discussed. (M.C.G.)

33460 RADIOLYSIS OF 4-THIOURACIL AND OF THE 4-THIOURACIL MOIETIES OF 4-THIOURIDINE AND TRANSFER RIBONUCLEIC ACID FROM ESCHERICHIA COLI IN AQUEOUS SOLUTIONS. Soerbo, Bo; Lundberg, Bo (Research Inst. of National Defence, Sundbyberg, Sweden). Biochim. Biophys. Acta, 157: 445-54(May 21, 1968).

4-Thiouracil, 4-thiouridine, and tRNA from Escherichia coli were irradiated with x rays in air-saturated solutions and the radiolysis of the 4-thiouracil moieties was determined spectrophotometrically. The dose−effect curves were exponential, giving initial yields of destruction (G value) of 3.22 for thiouracil, 2.45 for thiouridine, and 0.31 for the thiouracil residues in tRNA. The thiopyrimidine residues were more radiolabile than the corresponding oxygen analogs, as the G values found for uracil and uridine under the same conditions were 2.28 and 1.83, respectively. The following radiolysis products were demonstrated in irradiated thiouracil solutions: uracil, thiouracil disulfide, isobarbituric acid, di-isobarbituric acid, and inorganic sulfate. Radiolysis products identified in irradiated thiouridine solutions were uridine, thiouridine disulfide, and sulfate. (auth)

33461 POLYANIONS AND THEIR COMPLEXES. PART IV. A PULSE RADIOLYSIS STUDY OF THE INTERACTION BETWEEN METHYLENE BLUE AND HEPARIN IN AQUEOUS SOLUTION. Balazs, E. A. (Retina Foundation, Boston); Davies, J. V.; Phillips, G. O.; Scheufele, D. S. J. Chem. Soc., C, No. 12, 1424-9(1968).

A new method is described for investigating ion-binding between polyanions and their associated counterions. The reactions of hydrated electrons (e^-_{aq}) produced during pulse radiolysis of aqueous solutions were used to examine specifically the interactions between the cationic dye methylene blue (MB^+) and anionic sites of heparin. The second-order rate constant for the reaction $e^-_{aq} + MB^+ \rightarrow MB$ was measured (2.4×10^{10} mole^{-1} sec^{-1}). In the presence of heparin and D-glucose (to remove OH radicals), the fast reaction $e^-_{aq} + MB^+$ was replaced by a considerably slower reaction. Ion-binding at the anionic site of the polyanion, by short-range interaction forces, led to charge neutralization of the counterion, with subsequent unreactivity towards e^-_{aq}. Agents that destroy the complex and reverse the metachromatic shift, namely addition of sodium chloride and methanol and increase in temperature, also induce a reversal of the e^-_{aq} rate, which therefore can be used as a specific criterion for site−dye interaction. (auth) (UK)

33462 CHEMICAL EFFECTS OF ION IMPLANTATION IN MOLECULAR SOLIDS. Andersen, T.; Langvad, T.; Sorensen, G. (Univ. of Aarhus, Denmark). Nature (London), 218: 1158-9 (June 22, 1968).

Implantation of energetic ions in ionic crystals was shown to simulate the chemical effects of nuclear processes, and to shed new light on the mechanism of thermal annealing of radioactive atoms generated in ionic crystals by nuclear transformations. The formation of labeled molecular inorganic solids by implantation of $^{57}Co^+$ ions in trans- and cis- $[Co\ en_2Cl_2]NO_3$ and of $^{64}Cu^+$ ions in α- and β-copper phthalocyanine, using the Aarhus isotope separator, was investigated. Energetic beams ranging from 20 to 60 keV were used, at room temperature, and the total number of implanted ions varied from 10^{11} to 10^{13} cm^{-2}. It was found that implanted energetic ions can also simulate the chemical effects of nuclear transformations in molecular inorganic solid compounds. The marked influence on the stereochemical configuration for the radiation stable trans-$[CO\ en_2Cl_2]NO_3$ and on the crystal structure of the Cu phthalocyanines shows that the labeling of molecules by ion implantation takes place by a mechanism equivalent to that for thermal annealing of recoil products generated by nuclear transformations in these solids. Whereas labeling of the target molecule is markedly dependent on the energy of the implanted ions, formation and labeling of the isomer are energy independent. It was shown that the thermal annealing process in molecular solids takes place in two steps. The first step involves trapping of an electron at the implanted ion, leading to a reduction of valence state. The second step may involve an isotopic exchange reaction between the reduced implanted ion and neighbor molecules, leading to a labeled target molecule. (UK)

33463 DIELECTRIC RELAXATION IN GAMMA-IRRADIATED TETRAFLUOROETHYLENE−HEXAFLUOROPROPYLENE COPOLYMERS AT LOW TEMPERATURES. Koizumi, Naokazu; Yano, Shinichi; Tsunashima, Kenji; Tsuji, Fukuju (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 46: No. 1, 30-6(1968).

Dielectric properties of copolymers of polytetrafluoroethylene and hexafluoropropylene were studied over the temperature range of 78 to 300°K at frequencies of 10 Hz to 100 kHz. Two relaxation regions were observed for both unirradiated and irradiated copolymers: one (the γ relaxation) appeared near 250°K and the other (the δ relaxation) at about 120°K at 100 kHz, respectively. The size of the γ loss peak increased with increasing the irradiation dose and decreased with the degree of crystallinity. The size of the δ loss peak, being much smaller than that of the γ one, increased not only with the irradiation dose but also with the heat treatment for annealing. The activation enthalpy and entropy were 16 kcal/mole and 30 eu for the γ relaxation and 3.5 kcal/mole and 0 eu for the δ relaxation, respectively. The values of these activation parameters in the γ relaxation increased slightly with increased irradiation doses, but those for the δ relaxation was not much influenced with the irradiation. The δ relaxation would be attributed to the dielectric relaxation of end groups in the copolymer. Infrared absorption spectra of highly irradiated copolymers showed the presence of the carboxylic group. (auth)

33464 SYNTHESIS OF DEFECTS IN IRRADIATED QUARTZ. Ichikawa, Yoneta (Nara Univ. of Education, Japan). Bull. Inst. Chem. Res., Kyoto Univ., 46: No. 1, 26-9(1968).

Glow curves of the natural quartz irradiated by γ rays were observed for various doses and each glow peak was resolved into three component peaks, B_1, B_2, and C. The glow peaks caused by the diffusion of impurities in the condition of 1000°C were compared with these peaks and the nature of defect responsible for each peak was determined. The defects for the B_1 peak were associated with the Al-defect, the defects for the B_2 peak were due to the disturbed-network in the vicinity of Li and the defects for the D peak were due to oxygen vacancy. Moreover, the interaction of these defects was discussed from the result of variation of the area of glow curves for various doses. (auth)

33465 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF STYRENE ONTO POLY(VINYL ALCOHOL) IN THE PRESENCE OF CARBON TETRACHLORIDE. Sakurada, Ichiro; Ikada, Yoshito; Yamaoka, Takashi; Horii, Fumitaka (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 46: No. 1, 13-22(1968).

The grafting of styrene onto poly(vinyl alcohol) (PVA) films by pre-irradiation technique was studied in the presence of carbon tetrachloride (CCl_4). It was found that lengths of the grafted branch could be lowered expectedly by the use of CCl_4. The chain transfer constant, C_s, estimated from the change in degree of polymerization of the homopolymer formed in the interior of the films was 8.0×10^{-3}, and it was in good agreement with the C_s found for the conventional catalytic polymerization. Not only the percent grafting and the graft efficiency, but also the overall rate of polymerization were decreased with increasing concentration of CCl_4, similarly in the case of PVA–methyl methacrylate graft copolymerization. The graft copolymer was carefully isolated from both the homopolymer and the ungrafted PVA, in order to make it possible to discuss the grafting mechanism in detail. It was concluded that the number of branch and the grafted PVA per unit weight of starting PVA films was decreased with increasing concentration of CCl_4. However, when the calculation was made using the data obtained after the conventional, simple extraction of the homopolymer, the opposite conclusion was drawn that the number of branches was increased with CCl_4. This finding suggests strongly that it is essential to isolate the pure graft copolymer, in order to obtain any definite conclusion on the mechanism of grafting and the chemical structure of graft copolymer. (auth)

33466 STUDY OF THE POLYSTYRENE OBTAINED IN THE CELLULOSE-STYRENE COPOLYMERIZATION. Gagnaire, Didier; Vincendon, Marc (Centre d'Etudes Nucleaires, Grenoble, France). Bull. Soc. Chim. Fr., No. 4, 1304-7(Apr. 1968). (In French).

Polystyrene grafted onto rayon by γ irradiation was liberated by acid hydrolysis of the copolymer. This polymer contains a large number of points along the chain, subject to chemical attack by $PBr_2(C_6H_5)_3$, a reagent that breaks ether linkages. This copolymer is currently thought to contain a maximum of two cellulose chains grafted by the extremities of the polystyrene. The results showed that the liberated polystyrene chain is cut by the reagent and supports a different picture where branching occurs during the graft. (auth)

33467 RADIATION CHEMISTRY. Magat, Michel (Faculte des Sciences, Orsay, France). Entropie, No. 21, 15-20(May-June 1968). (In French).

Present theoretical ideas about processes taking place during irradiation of matter by ionizing radiations are presented and it is shown that in this first period, called physical period, there is formation of ions and of excited molecules. During a second, physicochemical period, an evolution of these species takes place which leads to the formation of free radicals and of ions of relatively long life time. During a third, chemical period, these active species reach with the substrate, according to rules well known from elsewhere. It is hence possible to predict to a certain extent the final products that will be formed as result of irradiation by ionizing radiations. Some possible industrial applications of this mode of activation of molecules are indicated. (auth)

33468 STUDIES OF ELECTRON-EXCITED MOLECULES IN SOLUTIONS BY MEANS OF SENSITIZED O-NITROBENZALDEHYDE RE-GROUPING. Samokhvalova, L. I.; Krongauz, V. A. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 177: 1134-7(Dec. 11, 1967). (In Russian).

Light or ionizing radiation-induced isomerization of o-nitrobenzaldehyde was studied using benzene as a sensitizer. A mercury tube PRK-2, working at low pressure, combined with a chlorobromine gas filter and producing pure line $\lambda = 253.7$ mμ was used as a light source and ^{60}Co γ ray with $\approx 2 \times 10^{18}$ eV/l sec was used as the ionizing source. The amount of the o-nitrosobenzoic acid formed was determined either by spectrophotometry or titration. The methods produced almost identical results. Diagrams are given of the quantum yield from o-nitrobenzaldehyde re-grouping into o-nitrosobenzoic acid as a function of its concentration in benzene under the effects of $\lambda = 253.7$ mμ. The radiation yield of aldehide–acid re-grouping as a function of concentration in solutions was determined by radiolysis of dilute o-nitrobenzaldehyde solutions in benzene. (R.V.J.)

33469 INTRINSIC STRUCTURE OF POLYMERS OBTAINED BY RADIOCHEMICAL POLYMERIZATION OF SOLID ACENAPHTHYLENE. Muller, Jean-Claude. J. Chim. Phys., 65: 655-60 (Apr. 1968). (In French).

The ultraviolet spectrum of benzene solutions of polyacenaphthylene obtained by irradiation of solid monomer presents two bands at 3,860 and 4,070 Å which were not found when the polymer was initiated by other means. It was found that these bands which, qualitatively, are rather similar to those appearing in the ultraviolet spectrum of the oligomers of acenaphthylene (fluorocyclene or diacenaphthylidene) cannot be attributed to such oligomers synthesized by irradiation, at the same time as the polymer containing them. They are presumably due to diacenaphthylidene-like conjugated structures and their intensity was found to be related to the molecular weight of the polymer, but no more definite interpretation can be given for their origin. (auth)

33470 CHEMICAL REACTIONS OF HOT ATOMS. Berei, Klara; Vasaros, Laszlo. Atomtech. Tajek., 11: 83-96(1968). (In Hungarian).

A review of hot atom chemistry based on literary examples and experimental work is presented. The place of the chemistry of hot atoms in science, the production of high-energy particles, the initial energy of atoms formed in nuclear transformations, slowing down effects, the theory of hot atoms, and the practical applications of the chemical consequences of nuclear transformations are discussed. (auth)

33471 RADIOLYSIS OF PETROLEUM PRODUCTS. Lujan, Javier Reyes Rev. Mex. Fis., 17: No. 1, 1-17(1968). (In Spanish).

PEMEX lubricants and refinery residuals were subjected to ^{60}Co gamma radiation and 19-MeV electrons, at temperatures between 25 and 60°C, dose range from 1 to 80 Mrad. G values for hydrogen and methane and their variation with dose rate in the range between 0.0039 and 25 Mrad/min were determined. (auth)

33472 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF STYRENE AND NYLON. Das Gupta, S.; Slobodian, J. T. Canadian Patent 783,036. Apr. 16, 1968.

Graft copolymers of styrene and nylon, when the nylon is fabric, moulding powder, filament or film, were prepared using high energy radiation and aqueous alcoholic solutions of styrene. Both simultaneous and pre-irradiation techniques were used. In the simultaneous irradiation process, nylon samples were immersed in the reaction mixture and irradiated at different dose levels of 1.2×10^6 RADs/hr. In the latter process, samples were irradiated in water before the monomer solution was added and a low radiation dose initiated the grafting. Nylon so treated is superior in wearability and water resistance to that commercially available. (F.S.A.)

33473 PROMOTION BY SF_6 OF A RADIOLYTICALLY INDUCED CHAIN REACTION FOR THE GEOMETRICAL ISOMERISATION OF CIS- OR TRANS- BUTENE-2 IN DILUTE GASEOUS MIXTURES. Hummel, R. W. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Nature (London), 218: 1050-1(June 15, 1968).

G-values of ~20,000, at near-ambient temperatures, were obtained by the use of SF_6 in these conversions, whereas in the absence of SF_6 values were <10. This indicates a chain length >2,000 for the SF_6 promoted isomerisation. The system studied comprised a mixture of argon with 9.5 mole % cis-butene-2 and 1.25 mole % SF_6. Irradiation was with ^{60}Co gamma at a dose rate of $\sim 2 \times 10^{19}$ eV/l/hr, at 760 torr. Gas chromatography was employed for analysis. After a short induction period, which might have been due to O_2 in the argon, conversion was linear with dose for at least 20 min., when about half conversion was reached, and the process was virtually complete after ~1 hr., when a 3 : 1 trans-cis equilibrium ratio was obtained. The same ratio was essentially obtained starting with the trans-isomer. It was found that purely thermal processes involving SF_6 played little or no part in the radiolytic reaction at ambient temperatures. Irradiation of mixtures containing CH_4 instead of Ar as chief component gave a similarly increased isomerisation yield in the presence of SF_6, indicating that the direct effect of the very different excited and ionised species from CH_4 and Ar is negligible compared with the indirect effect induced by SF_6. Radicals from CH_4 also seemed unimportant. It appears that a charged species derived from SF_6 is responsible for the high G-values. A possible mechanism is suggested. (UK)

Radiochemistry

Refer also to abstracts 33379, 33380, and 35331.

33474 (NP-17502) USERS' GUIDES FOR RADIOACTIVITY STANDARDS. Kahn, B.; Choppin, G. R.; Taylor, J. G. V. (National Academy of Sciences–National Research Council, Washington, D. C.). Oct. 1967. 43p. Dep. CFSTI.

Chemical and counting problems for radioactivity standards in common use or expected to be available are presented. The guides are prepared separately for every element. Guides are presented for Na, Mg, P, K, Ca, Cr, Fe, Co, Zn, Ga, As, Br, Kr, Sr, Y, Zr, Nb, Ru, Rh, Ag, Sn, Sb, Te, I, Cs, Ba, rare earths, Ir, Au, Hg, Tl, Po, Rn, Ra, Th, U, Np, and Am. (M.C.G.)

33475 SOLUTION KINETICS OF RADIOACTIVE STRONTIUM SULFATE PRECIPITATES IN WATER. Spitsyn, Vikt. I.; Gromov, V. V.; Bespalova, T. N. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 179: 144-7(Mar. 1, 1968). (In Russian).

In view of the fact that the dissolution kinetics of strontium sulfate is related to the structure of the compound, radioinduced crystal defects are expected to influence the dissolution process.

This problem was investigated by conductivity and radiometric studies, assuming that the composition of the salt is not affected by its dissolution. The radioactive precipitate was prepared by using Na_2SO_4 containing from 0.01 to 400 mCi of ^{35}S and $SrCl_2$ solutions; the various fractions of size and shape of the precipitate were separated by sedimentation. It was found that the dissolution rate of the radioactive material was much higher than that of the inert compound. The calculations showed that the energy of activation of the nonradioactive $SrSO_4$ is lower than that of the radioactive material, −5 and 6.5 kcal/mole, respectively; this agrees with the findings concerning the variations of the dissolution rate. Thus, the dissolution rate is a structure-sensitive property of this compound. (TTT)

33476 DIFFUSION OF ^{37}Ar IN NEUTRON-IRRADIATED CaO CRYSTALS. PART 38. INFORMATION ON RARE GASES IN SOLIDS. Felix, F. W.; Beer, D. (Hahn-Meitner-Institut, Berlin). Nukleonik, 11: 106-7(May 1968). (In German).

Neutron irradiated CaO crystals contain radioactive ^{37}Ar formed by the (n,α)-reaction on ^{40}Ca. The release of Ar during isothermal anneals showed a burst followed by volume diffusion kinetics. The diffusion of Ar between 1100 and 1800°C can be described by the Arrhenius-parameters $D_0 = 0.55\ cm^2s^{-1}$ and $\Delta H = 3.5$ eV. Diffusion depends on neutron dose, thus indicating an interaction of the Ar atom with defects. (auth)

Separation Processes

Refer also to abstracts 33208, 33237, 33238, 33256, 33258, 33332, 33359, 33379, 33581, 34021, 35422, and 35737.

33477 (AD-663129) ADSORPTION OF TRACE ELEMENTS FROM SEAWATER BY CHELEX 100. Goya, H. A.; Lai, M. G. (Naval Radiological Defense Lab., San Francisco, Calif.). Sept. 8, 1967. 16p. (USNRDL-TR-67-129). CFSTI.

Chelex 100 was evaluated as an ion-exchange resin for the extraction of trace elements from seawater. A modification of the limited bath technique was used, in which resin was added to a solution containing the trace element. After time for equilibration, the solution was analyzed and the fraction of the activity adsorbed by the resin was determined. Chelex 100 appears to be an excellent ion exchanger for extracting a number of trace elements from seawater. These include: Ni, Zn, Ce, La, Tm, Pb, Am, Tb, Mn, Bi, Pu, Cr, Th, Co, Cd, Fe, and Hg. (auth) (USGRDR)

33478 (AERE-R-5724) TREATMENT OF LOW LEVEL RADIOACTIVE EFFLUENT BY A FERRIC HYDROXIDE PRECIPITATION. Clarke, J. H.; Cumberland, R. F.; Smyth, M. J. (Atomic Energy Research Establishment, Harwell (England)). Apr. 1968. 17p. Dep. CFSTI. UK 3s. 0d.

An account is given of laboratory and pilot plant investigations into the use of a ferric hydroxide precipitation method for the treatment of low-level active effluent at Harwell. Details are also given of the results obtained on the main treatment plant over several months of operation. (auth) (UK)

33479 (DOCKET-50201-1) NEPTUNIUM RECOVERY FACILITY AT WEST VALLEY REPROCESSING PLANT. Preliminary Safety Analysis Report, Part B. (Nuclear Fuel Services, Inc., West Valley, N. Y. New York State Atomic and Space Development Authority, New York). Jan. 2, 1968. 158p. Dep. CFSTI.

A request for authorization of recovery of neptunium at the West Valley Reprocessing Plant is recorded. Information supporting the request is given under the following headings: introduction, site description, facility description, process description, equipment description, engineering analysis, protection of the public, protection of plant personnel, and facility operations. The neptunium in the waste is separated from the bulk of the impurities using a conventional pulse-type liquid-liquid solvent extraction system. It is further purified and separated from the uranium and plutonium by ion exchange. (M.C.G.)

33480 (DOCKET-50201-4) [SPENT FUEL PROCESSING PLANT]. [Preliminary Safety Analysis Report, Part B, Vol. 3]. (Nuclear Fuel Services, Inc., [West Valley, N. Y.]). [July 26, 1962]. 400p. Dep. CFSTI.

Information for safety analysis of the West Valley Reprocessing Plant is given under the following headings: protection of the public, protection of plant personnel, and plant operation. Tables on maloperation, including results, indications, and corrective actions, are given for the various components. Appendixes include: public water supply data, site preparation specification, office building specification, warehouse specification, process building office outline specification, piping specifications, general electrical specifications, equipment specifications, cask acceptance criteria, equipment list, boron poisoning of dissolver concrete center plug, dissolver ^{235}U safe concentration limits and boron poisoning requirements, calculations and discussions in support of tables, area and process radiation monitoring system specifications, waste tank leakage, iodine dose to thyroid from 10^{20} fissions, criticality incident in fuel pool, atmospheric dispersion calculations, iodine activity, curriculum for chemical process operators and senior process operators, area radiation alarm system, personal dosimeters and protective clothing, air sampling and monitoring equipment, counting equipment, environmental monitoring, and format and general index for standard operating procedures. A report of the status of completion of construction and research and development aspects for the period ending April 1, 1965, is included. (M.C.G.)

33481 (DOCKET-50201-5) [WEST VALLEY REPROCESSING PLANT]. Application for Amendment to License No. CSF-1 to Authorize Recovery of Neptunium. Part A. (Nuclear Fuel Services, Inc., West Valley, N. Y. New York State Atomic and Space Development Authority, New York). Nov. 13, 1967. 7p. Dep. CFSTI.

A request for authorization of recovery of neptunium at the West Valley Processing Plant is recorded. Corporate information, relation to the New York State Atomic and Space Development Authority, financial and technical qualifications, and completion date are discussed. (M.C.G.)

33482 (DOCKET-50201-6) [WEST VALLEY REPROCESSING PLANT]. [Preliminary Safety Analysis Report], Amendment 1, Part B. Safety Analysis. (Nuclear Fuel Services, Inc., West Valley, N. Y.). Oct. 12, 1962. 29p. Dep. CFSTI.

Design changes in the West Valley Reprocessing Plant and their effects on the safety analysis are summarized. Topics covered include: elimination of Thorex equipment, reduced capacity for stainless steel-cermet fuels, waste storage facilities, and removal of one dissolver. Answers to eleven questions raised by the Division of Licensing and Regulation are given. (M.C.G.)

33483 (DOCKET-50201-7) [WEST VALLEY REPROCESSING PLANT]. [Preliminary Safety Analysis Report], Amendment 6. (Nuclear Fuel Services, Inc., West Valley, N. Y. New York State Atomic and Space Development Authority, New York). Nov. 15, 1967. 7p. Dep. CFSTI.

An application for amendment of the license CSF-1 for the West Valley Reprocessing Plant to authorize recovery of neptunium is recorded. In support of this application a description of the applicant, relation of the facility to National Fuel Services, financial and technical qualifications, and completion date are discussed. (M.C.G.)

33484 (EURFNR-463) DISTRIBUTION DATA FOR Pu(IV) AND U(VI) AND THEIR CALCULATION, IN TRIBUTYL PHOSPHATE AND METAL NITRATE/NITRIC ACID SYSTEM. Ochsenfeld, W.; Baumgaertel, G.; Schmieder, H.; Kuhn, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated from report KFK-671. 22p. (EUR-3703). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 14559.

33485 (IAN-Q-7) SEPARACION DE ISOMEROS NUCLEARES DE TELURO EN DIYODODIMETIL TELURO Y PICRATO DE DIMETIL TELURO. (Separation of Tellurium Nuclear Isomers in Tellurium Diiododimethyl and Tellurium Dimethyl Picrate). Carrillo, L.; Nassiff, S. J. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion de Quimica). 1967. 22p. (In Spanish). Dep.

The isomers $^{127m/127}Te$ and $^{129m/129}Te$, previously present in the tetravalent state in molecules of diiododimethyltellurium and dimethyltellurium picrate, were separated. In diiododimethyltellurium the yield for the separation was 94.5 ± 3.5% for $^{127m/127}Te$ and 61.4 ± 1.1% for $^{129m/129}Te$. In dimethyltellurium picrate the separation was 93.4 ± 3.4% for $^{127m/127}Te$ and 64.5 ± 4.0% for $^{129m/129}Te$. The isomers of tellurium in the ground state were separated carrier-free. (tr-auth)

33486 (IN-1181) DESCRIPTION OF THE PILOT PLANT FOR THE HEADEND REPROCESSING OF UNIRRADIATED ROVER FUELS. Kilian, D. C.; Roeh, A. P.; Dickey, B. R. (Idaho Nuclear Corp., Idaho Falls). May 1968. Contract AT(10-1)-1230. 19p. Dep. CFSTI.

A nonradioactive pilot plant facility for the headend processing of graphite-matrix nuclear rocket (Rover) fuel is described. The graphite matrix is removed by burning in an inert alumina bed fluidized with oxygen; the uranium is converted to the nonvolatile oxide, U_3O_8, and separated from the bed by elutriation from the burner. Solids scrubbed from the off-gas are dissolved in nitric acid, producing a solution suitable for solvent extraction of the uranium. (auth)

33487 (ORNL-TM-2092) HAZARDS EVALUATION FOR THE FLUIDIZED-BED VOLATILITY PILOT PLANT. Youngblood, E. L.; Miles, F. W. (Oak Ridge National Lab., Tenn.). July 1968. Contract W-7405-eng-26. 133p. Dep. CFSTI.

The hazards associated with the operation of the Fluidized-Bed Volatility Pilot Plant (FBVPP) were evaluated. The purpose of the FBVPP is to demonstrate the recovery and purification of uranium and plutonium from low-enriched UO_2 fuel by the fluoride-volatility method. Up to 40 kg of uranium and 2 kg of plutonium are processed per run. The major hazards in the system involve containment during the handling of plutonium, uranium, and fission products; criticality control; and the use of highly reactive chemicals such as fluorine, BrF_5, and HCl. The chemical process, process equipment, building, ventilation system, off-gas system, waste system, and auxiliary system are discussed. Shielding, radiation monitoring, and criticality control in the pilot plant are discussed. The likelihood and consequences of accidents such as the release of radioactive or toxic materials, explosions, and criticality incidents are considered. Safety features that were incorporated into the system to prevent these accidents are emphasized. The maximum credible accident is assumed to be a nuclear excursion in which a process vessel containing plutonium and fission products is ruptured inside a primary containment cell. (auth)

33488 (WAPD-Trans-89) THE SEPARATION OF Sm, Pm, AND Nd BY ANION EXCHANGE WITH MIXED SOLVENTS. Ross, R.; Roemer, J. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Isotopenpraxis, 3: 197-8(1967). 14p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 2188.

33489 RELATION BETWEEN CHEMICAL STRUCTURE OF PHOSPHONATES AND THEIR EXTRACTION CAPACITY WITH RESPECT TO URANIUM AND THORIUM. Shih, Li-lan; Chang, Tseng-jui; Yuan, Ch'eng-yeh. Yuan Tzu Neng, No. 3, 239-44 (1965). (In Chinese).

A study was made of the influence of chemical structure of 3 phosphonates on their capacity to extract U^{6+} and Th^{4+} from nitric acid solutions (1-12 M). As an example, $C_6H_5P(O)(OC_4H_9)_2$ (I), cyclo-$C_6H_{11}P(O)(OC_4H_9)_2$ (II), and n-$C_6H_{13}P(O)(OC_4H_9)_2$ (III) were studied. For the sake of comparison a study was also made on tri-n-butyl phosphate (IV). The physical constants of I-IV, as well as infrared spectra, were compared with extraction power of I-IV. The effectiveness of the extraction of U^{6+} and Th was determined by the density of electric charges on the O atom of the group P = O, but the space effects also play an important role. It was established that the distribution coefficients of U^{6+} and Th increase in the series I < II < III. The study of infrared spectra of the complexes being extracted has revealed the presence of the connection between metal ions and O atom of the group P = O, whereas no connection between O atom and group P-O-C was observed. (JPRS)

33490 SINGULARITIES OF SORPTION KINETICS OF La, Nd, Zr, AND Hf ON CATION EXCHANGE RESIN KU-1. Legenchenko, I. A.; Strizhenyuk, S. L. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Fiz. Khim., 42: 1224-27(May 1968). (In Russian).

The kinetics of La, Nd, Zr, and Hf separation by sorption on cation exchange resin Ku-1 from low-concentration solutions were studied. A strong relation between the rate of the process and the size of the cation exchange resin and the rate of mixing indicated a significant influence of intrinsic mass transfer on process kinetics under given conditions. The data obtained were described by equations of the second Fick law. Effective diffusions coefficients calculated for two large ionite fractions coincided with one another. The same magnitudes calculated using the data obtained for small fractions proved considerably smaller. It was assumed that the difference was caused by unevenly reduced linear dimensions of ionite grain during transitions to smaller fractions and by the influence of external mass exchange. The rate of La and Nd sorption increased 20 to 25% and Zr and Hf 30 to 40% for each 10° increase in temperature. (tr-auth)

33491 SEPARATION OF NITROGEN, OXYGEN, AND ARGON ISOTOPES AT LOW-TEMPERATURE SORPTION ON ZEOLITES. Tolmachev, A. M.; Zotova, T. V.; Grishina, L. N. (Moscow State Univ.). Zh. Fiz. Khim., 42: 1263-66(May 1968). (In Russian).

The separation of nitrogen, oxygen, and argon isotopes on synthetic zeolite was studied using a special device with variable volume available for six progressive enrichments of the gas phase by corresponding isotopic molecules at constant pressure in the system. Separation of nitrogen isotopes was carried out on Ca A-type zeolite at 78°C and argon and oxygen isotopes at 90°K. The calculated magnitudes of single separation coefficients are given. Data obtained are in good agreement with the results obtained by distillation, thermal diffusion, ion exchange, and chemical exchange methods. (R.V.J.)

33492 ZONE ELECTROPHORESIS ON PAPER IN INORGANIC ANALYSIS. COMMUNICATION 1. THE USE OF ZONE ELECTROPHORESIS ON PAPER FOR THE SEPARATION OF INORGANIC IONS. (A REVIEW). Ryabchikov, D. I.; Korchemnaya, E. K.; Naumova, V. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 23: 741-9(May 1968). (In Russian).

The possibility of using zone electrophoresis on paper for the separation of inorganic ions is discussed. The method can be used for the rapid separation of small amounts of elements, the analysis of microsamples, semiconductors and other alloys, substances of high purity, for the separation of short-lived isotopes without a carrier, etc. The experimental techniques and the methods for localizing the separated elements on electrophoregrams are described. Examples are given of separating elements of close chemical properties, and elements of different analytical groups. (auth)

33493 PROTACTINIUM EXTRACTION WITH THE USE OF DI-2-ETHYLHEXYL PHOSPHORIC ACID. Myasoedov, B. F.; Molochnikova, N. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 23: 786-7(May 1968). (In Russian).

Protactinium is quantitatively extracted with bis(2-ethylhexyl) phosphate (D2EHPA) from HCl, HNO_3, and H_2SO_4 solutions within a wide range of acid concentrations. Even from 30 N H_2SO_4 protactinium is extracted quantitatively with an equal volume of a 0.1 M D2EHPA solution in benzene. (auth)

33494 SOLVENT EXTRACTION OF POLONIUM AND BISMUTH FROM NITRATE SOLUTIONS. Barbano, P. G.; Rigali, L. (CAMEN, Pisa, Italy). Radiochim. Acta, 8: 214-15(Dec. 1967).

The extraction of polonium and bismuth from nitric acid solutions by xylene solutions of a quaternary ammonium compound (Aliquat-336) was investigated. The possibility of using this method for a separation of polonium from bismuth was examined. (auth)

33495 RADIOCHEMICAL SEPARATIONS OF ^{45}Ca–^{46}Sc, ^{140}Ba–^{140}La, AND ^{85}Sr–^{133}Ba BY LIQUID–LIQUID EXTRACTION USING 1-PHENYL-3-METHYL-4-CAPRYL-PYRAZOLONE-5 AS EXTRACTING AGENT. Mirza, M. Y. (AEK Risoe, Roskilde, Denmark). Radiochim. Acta, 8: 216-18(Dec. 1967).

The extraction of Ca, Sr, Ba, Sc, La, and K ions from aqueous solutions at various pH's into methyl isobutyl ketone containing 1-phenyl-3-methyl-4-capryl-pyrazolone-5 was investigated. Quantitative extraction of Ca and Sc at pH 8 to 10 and pH 1.8 to 3 respectively and of Sr and La at pH 9.4 and pH 3 to 8 was utilized in the separation of these activities. Good yields and good decontamination factors were obtained. (auth)

33496 CONCENTRATION OF ALL RARE EARTH IMPURITIES IN RARE EARTH MATRICES OF THE CERIUM SUBGROUP. Molnar, F.; Lebedev, N. A. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 205-10(1968). (In Hungarian).

The separability of all the rare earth impurities from cerium sub-group matrices was investigated. It was found that anion exchange chromatography, carried out with aqueous-methanol solutions of nitrates, provides a useful method for the concentration of all the rare earth impurities in neodymium and gadolinium matrices. The concentrate of the impurities can be processed further as required by the method chosen for their analytical determination. (auth)

33497 EXTRACTION OF U(VI) FROM AQUEOUS NITRIC ACID SOLUTION BY DI 2-ETHYLHEXYL PHOSPHORIC ACID. Asano, Mitsuru; Kohsaka, Nobutoshi (Kyoto Univ.). Tech. Rep. Eng. Res. Inst., Kyoto Univ., No. 140, 13p.(Mar. 1968).

The extraction reactions of U(VI) with di(2-ethylhexy) phosphate from aqueous nitric acid solution have been discussed by studying infrared spectra of U(VI) extracted into organic phases. With the assumption of the reaction order of di(2-ethylhexyl) phosphate concentration for the association extraction reaction of uranyl nitrate with di(2-ethylhexyl) phosphate to be second, the extraction behavior of U(VI) has been analyzed. From the fact that the calculated values of the equilibrium constant for such an extraction reaction become almost constant irrespective of both concentrations of nitric acid and di(2-ethylhexyl) phosphate, it may be concluded that the above assumption is more likely. (auth)

33498 KINETICS AND MECHANISM OF DESORPTION PROCESS OF NEODYMIUM AND ERBIUM WITH CATION EXCHANGER KY-2. Legenchenko, I. A.; Burdukevich, V. I. (Inst. of General and Inorganic Chemistry, Moscow). Ukr. Khim. Zh., 34: 323-30(1968). (In Russian).

Desorption of Nd and Er by solutions of sodium ammonium (pH 9) and sodium (pH 10.6) salts of ethylenediaminotetraacetic acid was investigated. The transition from solutions of low pH to those of higher pH resulted in a considerable slow down of the desorption process and an abnormal influence of temperature on the rate of the process. A positive influence of the products of reaction on the rate of the desorption by Na_4EDTA solution was observed. Tabulated data are given on the duration of the semi-transformation process of Nd and Er desorption at various conditions. (R.V.J.)

33499 PREPARATION OF THE ISOTOPES OF HYDROGEN BY CHROMATOGRAPHY IN A MOVING BED. Clayer, Arlette; Agneray, Louis; Vandenbussche, Gerard; Petel, Pierre (Societe de Recherches Techniques et Industrielles, Boulogne, France). Z. Anal. Chem., 236: 240-9(1968). (In French).

The principle of a continuous process is as follows: in a vertical column silicagel flows downward, by gravity, in a moving bed. The gaseous mixture to be separated (protium/deuterium) is introduced into the central portion of this column. Separation of the mixture into its two constituents is achieved by a counter-current exchange between the gaseous phase and the adsorbed phase. Protium less adsorbed is withdrawn at the top, deuterium is withdrawn at the bottom. The reflux is produced, at the bottom of the column, by two different means, depending on the type of desorption used: silicagel-desorption by rise of temperature and deuterium-elution by helium or displacing of deuterium by nitrogen. The gases produced are mixed with helium (1st case), or not (2nd case). Silicagel is carried again onto the top of the column by pneumatic transport. The experiments presented were carried out by means of nitrogen as displacing gas. (auth)

33500 SEPARATION OF LANTHANIDES AND OF TRIVALENT ACTINIDES ON ION EXCHANGERS BY HYDROXYETHYLENEDIAMINETRIACETIC ACID. Merciny, E. (Univ., Liege). Z. Anal. Chem., 236: 498-506(1968). (In French).

A study of the chromatographic separation of lanthanides and trivalent actinides by elution with hydroxyethylenediaminetriacetic acid, on cationic resin, showed the following results: (1) The efficiency of the column, characterized by the number of theoretical plates, varies considerably with the concentration of alkaline salts in the eluant. The increase in the number of plates depends inversely on the radius of hydrated cations. The nature of anions has no influence on the number of plates. (2) At a certain value of ionic strength, in a very limited range of pH, the change in partition coefficient with pH shows certain anomalies, observed with trivalent cations. It has been remarked that, in this zone of critical pH the number of plates increases considerably, while the separation factor shows an important decrease. With the help of electrochromatography and anionic exchange resins, it was found that in the solution negative complexes of lanthanides and trivalent actinides with HEDTA start to form in this zone of critical pH. (3) The apparent differences between the dissociation constant values of the complexes MeY of rare earths (group yttrium) observed previously by Spedding et al., and those observed with chromatograms are due to the existence of these new negative forms of complexes found only at certain experimental conditions. (auth)

33501 PLUTONIUM SEPARATION FROM NEUTRON IRRADIATED URANIUM MONOCARBIDE. Mannone, F. (CCR-EURATOM, Ispra, Italy). Radiochim. Acta, 8: 207-11(Dec. 1967).

The method described for separating a radiochemically pure solution of plutonium from neutron-irradiated uranium monocarbide is based on the oxydative degradation with $KMnO_4$ of organic compounds formed during the disolution of UC, followed by liquid-liquid extraction of Pu(IV) with 0.5$\underline{M}$ 2-thenoyltrifluoroacetone and subsequent adsorption on a Dowex 1 × 4 resin bed. The MnO_2 precipitate that forms during the oxydation with $KMnO_4$ acts as scavenger for zirconium, niobium, and, to a lesser extent, for cerium. Plutonium is recovered free from uranium, fission products, and americium. The gamma activity of the purified solution is due only to ^{239}Pu, ^{240}Pu, ^{241}Pu, and daughters (^{237}U and ^{241}Am), which begin to grow by the α and β decay of ^{241}Pu immediately after plutonium purification. (auth)

33502 SEPARATION OF URANIUM FROM OTHER ELEMENTS BY ION-EXCHANGE CHROMATOGRAPHY. Strelow, F. W. E.; van Zyl, C. R. (Council for Scientific and Industrial Research, Pretoria). J. S. Afr. Chem. Inst., 20: No. 1, 1-10 (1967).

After the samples were applied to AG50-X8 cation exchange resin $HCl-H_2O_2$ followed by HBr was used to elute W(VI), Mo(VI), Nb(V), V(V), In, Bi(III), Sn(IV), and Pb(II). Uranium(VI) was then eluted with HCl and the rare earths, Sr, Ba, Zr, Hf, and Th were retained on the column. AG1-X8 anion exchange resin was used to separate U from Fe(III), Ti(IV), Al, Ga, Be, bivalent heavy metals, and other elements by elution with H_2SO_4. Uranium was then eluted with HNO_3 or HCl. Tantalum interfered but could be separated by elution with HNO_3-tartaric acid from the first column. (D.H.M.)

33503 ELECTROLYTIC SEPARATION FACTOR OF PROTIUM AND DEUTERIUM. Rowland, P. R. (Atomic Energy Establishment, Winfrith, Eng.). Nature (London), 218: 945-6(June 8, 1968).

A comparison was made between the experimental (S) and theoretical maximum values ($\bar{S}$) of the separation factor. For purely chemical processes the maximum theoretical value is that for the production of free gaseous atoms from the reactant molecules (water of the electrolyte). For a 1:1 ratio of H and D in the electrolyte the separation factor is then the equilibrium constant for $\frac{1}{2}\,H_2O(1) + D(g) \rightleftharpoons \frac{1}{2}\,D_2O(1) + H(g)$ (detonated by $\bar{S}_0$). $\bar{S}_0$ was recalculated using a reduced partition function ratio $q(D_2O)/q(H_2O)$ computed from recent spectroscopic data. The vapor pressure ratio $p_0(H_2O)/p_0(D_2O)$ for the pure isotopic species was calculated from data by Jones (Report LADC 5905). Over the temperature range 0 to 60°C the value 0.53 exp (1840/RT) was obtained for $\bar{S}_0$. The average of maximum observed values was 0.56 exp (1715/RT), indicating remarkable agreement. The separation factor on mild steel and on iron was also reinvestigated, paying particular attention to analytical procedures, since small errors in isotope ratio determination are magnified in the results. This magnification was, however, minimized by using an electrolyte isotope ratio of 75% D. With nickel anodes and mild steel or pure iron cathodes the value of S was well below $\bar{S}_0$. This may have been an impurity effect. When a complexing agent such as EDTA, however, was added to the hot bath, results approached $\bar{S}_0$. $S_{optimum}$ was then found to be 0.52 exp (1820/RT). The results appeared to imply the unlikely circumstance of a transition state comparable with free gaseous atoms. It may be difficult to provide a simple explanation for the anomaly, but a number of possibilities are discussed. (UK)

33504 SYNERGISM AND DILUENT EFFECTS IN THE EXTRACTION OF CESIUM BY 4-sec-BUTYL-2-(α-METHYLBENZYL)PHENOL (BAMBP). Zingaro, R. A.; Coleman, C. F. (Oak Ridge National Lab., Tenn. Texas A and M. Univ., College Station). J. Inorg. Nucl. Chem., 29: 1287-1300(May 1968).

In order to understand better the nature of the extraction of cesium by 4-sec-butyl-2-(α-methylbenzyl)phenol (BAMBP), the effects of various synergistic reagents and diluents on the extraction were studied. The synergistic reagents included bis(2-ethylhexylester) of phosphoric acid (HDEHP) and two carboxylic acids, 4-phenylvaleric acid (HV) and heptadecylester of tetrapropenylsuccinic acid (HS). The diluents included octanol-1 (hydrogen bonded, donor type), acetophenone (nonhydrogen bonded, donor type), and chloroform (weakly hydrogen bonded, acceptor type), besides carbon tetrachloride and an aliphatic hydrocarbon. Synergism was slight at pH > 11, increasing in neutral and slightly acid solutions to, e.g., enhancement × >100 with 0.02 $\underline{M}$ HV-1 $\underline{M}$ BAMBP in CCl_4 and × >1000 with 0.01 $\underline{M}$ HDEHP-1 $\underline{M}$ BAMBP in hydrocarbon at pH = 7. The dependence of the extraction coefficient E_a^0 on BAMBP concentration in the presence of HDEHP and HV changed in different pH regions. The extraction chemistry was interpreted primarily on the basis of these extraction data. Infrared, NMR, and dielectric constant measurements were used to corroborate and extend understanding of the nature of the molecular interactions involved in these systems and their effects on the extraction mechanisms. The principal extract species appears to be $[Cs \cdot 4\ BAMBP]^+ Y^-$, where Y^- represents V^-, HV_2^-, HS_2^-, or $H(DEHP)_2^-$, plus some species with the anion directly coordinated to cesium: $CsY \cdot 2$ BAMBP and $CsV \cdot 3$ BAMBP. (auth) (UK)

33505 PROCESSING OF RADIOACTIVE WASTE IN THE NETHERLANDS. Houtman, J. P. W. (Reactor Inst., Delft, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 28, 97-113 (1968). (In Dutch).

The binding of several cations by clay and peat bog was studied experimentally. River clay binds Cs, Y, and Co very well. Binding by peat bog of Sr is considerably dependent on the presence of other ions. It was concluded that the layers of clay and peat bog in the Dutch soil have a huge purification capacity. (J.J.t B.)

33506 EUROCHEMIC FUEL-PROCESSING PLANT. Joseph, C. J. (Eurochemic, Mol, Belg.). RCN (Reactor Cent. Ned.) Meded., No. 28, 135-45(1968). (In Dutch).

The plant processes fuel elements with different geometries, canning materials, enrichments, fuel materials, and degrees of burnup. These are obtained from several European reactors. The complete canned elements are dissolved in nitric acid solutions. U and Pu are extracted with tributyl phosphate, Pu is backextracted by reduction and U by water, followed by a treatment with silica gel. Instrumentation and technical details are discussed.

The plant has a capacity of 350 kg/day low-enriched U and 10 kg/day highly enriched U. (J.J.t B.)

33507 PURIFICATION AND CONDITIONING OF PLUTONIUM. Van Geel, J. N. C. (Eurochemic, Mol, Belg.). RCN (Reactor Cent. Ned.) Meded., No. 28, 147-57(1968). (In Dutch).

Pu is extracted with trilaurylamine from a tributyl phosphate solution, which is the second step in the processing of fuel. Then precipitation is induced with an aqueous solution of oxalic and nitric acid. Details of reaction mechanisms and conditions are given. (J.J.t B.)

33508 NORWEGIAN-DUTCH RESEARCH IN FUEL-PROCESSING. Kraak, W. (Reactor Centrum Nederland, Petten, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 28, 159-72(1968). (In Dutch).

Fuel elements of the JEEP Reactor are taken from their cans and dissolved in nitric acid. The Purex process in which U and Pu are extracted with tributyl phosphate is used as a second step, followed by backextraction of U by reduction. A third extraction column is used for the backextraction of Pu with dilute nitric acid. Details of the process and several improvements are given. (J.J.t B.)

33509 CHLORINATION OF NINGYOTOGE URANIUM ORE. Ino, Shiro; Kodama, Kenjiro; Suzuki, Takamura. Tokyo Kogyo Shikensho Hokoku, 63: 51-62(Feb. 1968). (In Japanese).

The recovery of uranium from Ningyotoge ore by chlorination was studied. Ningyotoge ore containing 0.065 to 0.24% of U_3O_8 was pulverized to pass the 150 mesh screen, granulated to small balls of 3 to 7 mm diameter by water and chlorinated on the fixed bed by the mixture of Cl_2, CO, and CO_2. The main factors affecting the vaporization of uranium as chloride were dehydration condition of the ore, temperature and time of chlorination, and composition of chlorinating gas and its velocity. Optimum dehydration of the ore was attained when it was heated to the chlorination temperature within 2 hr in the flowing CO_2 atmosphere. Good results were obtained on the chlorination for 2 hr at 900 to 950°C by a mixture of Cl_2, CO, and CO_2 whose component ratio was 1, 1, and 6 in volume respectively. On the chlorination of the ore, the proportion of uranium vaporized from it was about 80%. Most of the Cl_2 was consumed to react with the silicates, feldspar, and clay. (auth)

33510 FRACTIONAL CONDENSATION OF THE CHLORIDE VAPOR FROM THE URANIUM ORE CHLORINATED. Ino, Shiro; Tomizawa, Satoshi; Kamiya, Kunio; Suzuki, Takamura. Tokyo Kogyo Shikensho Hokoku, 63: 63-74(Feb. 1968). (In Japanese).

The condensates obtained from Ningyotoge uranium ore by chlorination at 900 to 950°C, contain the various chlorides derived from the components of the ore besides the uranium chloride, and the concentration of the uranium chloride in the total condensate was less than 4%. Fractional condensation of chloride vapors was, therefore, investigated for the purpose of concentrating the uranium. When the fractional condensation was carried out using the condenser previously added with a small quantity of NaCl, 98% of the uranium chloride vaporized was condensed in the temperature zone above 650°C according to the chlorination condition, and the concentration of the uranium chloride was attained up to about 30% in the condensate. The interaction of chloride components had a great effect on the condensation and led to the different results, one of which was inferred from the vapor pressures of the individual chlorides. (auth)

33511 PREPARATION OF PURE CERIUM(IV) PREPARATION BY SORPTION PURIFICATION METHOD. Vagina, N. S.; Wang, Fam Kwak (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim., 13: 1600-2(June 1968). (In Russian).

Separation of high-purity cerium from Pr and Tm impurities using a sulfuric acid–ammonium acetate mixture was studied. The distribution of Ce and Pr between the solution and sorbent as a function of the pH of sulfate–acetate mixture was tabulated and separation of CeO_3 from Pr_6O_{11} and Tm_2O_3 was analyzed. The tabulated data on the separation of synthetic mixtures showed that the content of Pr in cerium preparation was one or two orders less than in the initial mixture. Repeated purification of Ce mixtures produced cerium preparations with 6.6×10^{-4}% Pr and 7.4×10^{-4}% Tm. (R.V.J.)

33512 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. IV. EXTRACTION OF STRONTIUM BY SOME DIALKYL PHOSPHORIC ACIDS. Kolarik, Z.; Hejna, J.; Moravec, A. (Nuclear Research Inst., Rez, Czech.). J. Inorg. Nucl. Chem., 29: 1279-85(May 1967).

The extraction of strontium by dialkyl ester of phosphoric acids, where the alkyl is n-butyl, n-amyl, n-octyl and 2-ethylhexyl, was studied. The highest distribution ratio (q_{Sr}) that can be reached increases with increasing number of carbon atoms in the straight alkyl chain, but in the region of low q_{Sr} the length of the n-alkyl group does not affect the extraction efficiency. Branching of the alkyl group reduces the ability of the dialkyl ester of phosphoric acid to extract strontium. The extraction efficiency decreases in the series of diluents: aliphatic hydrocarbons > cyclohexane > carbon tetrachloride > toluene. The composition of the strontium complexes with di-n-amyl phosphate in cyclohexane and carbon tetrachloride is $SrA_2 \cdot 3HA$. If $-\log [H^+] > 3.5$ for the aqueous phase, the complex $SrA_2 \cdot xHA(5 - x)NaA$ is formed in cyclohexane, and SrA_4^{2-} in the aqueous phase. (auth) (UK)

33513 CHLORINATION OF NINGYOTOGE URANIUM ORE BY A MOVING BED TEST PLANT. Suzuki, Takamura; Ino, Shiro; Toyama, Shigeki; Tomizawa, Satoshi; Kodama, Kenjiro. Tokyo Kogyo Shikensho Hokoku, 63: 75-81(Feb. 1968). (In Japanese).

In order to develop a refining process for uranium, the chlorination of Ningyotoge uranium ore was studied in a moving bed pilot plant. The problems in the plant were studied out and the troubles were surmounted. At the same time, the rates of reaction and the heat transfer data were extended to correlate with the scale-up problems. (auth)

33514 DECOMPOSITON OF THE GRAPHITE MATRIX BY CESIUM METAL. A USE FOR REPROCESSING PYROLYTIC-CARBON-COATED NUCLEAR FUELS. Merz, E. (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 11: 38-44(1968). (In German).

In reprocessing coated particle-type fuel, the particles first must be detached from the pyrocarbon layers prior to chemical separation and purification. For this purpose, the spontaneous reaction of graphite with cesium and the resulting destruction of the graphite crystal lattice may be used. The stripping of the coatings can be accomplished by reacting of liquid or gaseous metal in the temperature range from 50 to 300°C. Oxide fuel particles remain completely unattacked during the treatment, whereas particles composed of uranium dicarbide with a small overstoichiometric proportion of carbon are partly or completely decomposed. Subsequently the cesium is removed by heating the graphite sample to about 900 to 1000°C and thus can be reused. Applying wind segregation or some other suitable procedure, the nuclear fuel and the pyrocarbon coating shells may be separated from each other. Measurements were made of the kinetics of decomposition of cesium–graphite compounds over the temperature range from 900 to 1000°C. In addition, experimental studies and theoretical estimations were made of uranium and protactinium losses expected in the procedure. At moderately high operating temperatures, the heavy metal losses in the stripped-off pyrocarbon shells caused by diffusion processes, will probably be economical tolerable. However, at higher temperatures and by knock-out processes, there might occur a strong heavy metal transport into the shells. Hence this effect was estimated by using some related nuclear physics data; a final answer will only be possible after high burnup material is analyzed. (auth)

33515 DECOMPOSITION OF COATED NUCLEAR FUEL PARTICLES IN OXIDIZING ALKALI SALT MELTS. Riedel, H. J.; Merz, E. (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 11: 32-8(1968). (In German).

The possibility of processing nuclear fuels coated with pyrocarbon, silicon carbide, and boron carbide was investigated using strong oxidizing alkali salt melts. Salt melts consisting of potassium pyrosulfate are only applicable for the digestion of pyrocarbon coatings. However, they are particularly suited for a complete dissolution of mixed uranium–thorium fuel kernels. Fused melts of mixtures of alkali hydroxide and peroxide are capable of digesting all sorts of commonly used coated fuel particles. No attack occurs on highly sintered mixed oxide kernels. In addition, the efficacy of a nitrogen dioxide admixture, acting as oxidizing agent, was tested on fused NaOH-, $NaNO_3$-, $NaNO_3$ + $NaNO_2$-, and KCl + LiCl-salt melts. For all processing methods, the decontamination factors attainable are reported for the recovered uranium, including ^{233}Pa in the case where breeding elements were investigated. The practicability of the processing methods investigated are discussed in regard for applying them as a low decontamination salt cycle as well as for a head-end step in an aqueous reprocessing procedure. (auth)

33516 SEPARATION OF ACTINIUM AND RADIUM FROM THORIUM TARGET IRRADIATED BY 660 MeV PROTONS. Moskvin, L. N.; Tsaritsyna, L. G. At. Energ. (USSR), 24: 383-4(Apr. 1968). (In Russian).

A distributing-chromatographic method was developed for actinium and radium separation from thorium target irradiated by fast protons at 660 MeV. The chromatography was carried out in a column with a solution of nitric acid–TBP and with a hydrochloric acid solution of D2EHPA and with porous fluoroplast-4 used as immobile organic phase. Chromatograms of actinium and lanthanum, and of barium and radium separations are given. The evaluation of the completeness of separation was checked by chromatographic and mixed precipitation chromatographic methods. In the latter case after the target material was dropped on a distribution-chromatographic TBP column, the actinium was precipitated with YbF_3 and radium with lead sulfate. The obtained preparations of ^{25}Ac and ^{225}Ra were used for preparing γ and α sources in nuclear spectroscopy. (R.V.J.)

33517 ROLE AND UTILIZATION OF COMPLEXATION IN THE APPLICATION OF ION EXCHANGE RESINS. Tremillon, Bernard (Faculte des Sciences, Paris). Z. Anal. Chem., 236: 472-98(1968). (In French).

In the case of metal ions, the apparent affinity differences of the cation-exchanger sulfonate resins towards these cations can be varied by addition of numerous complexing agents to the solution. Cation exchangers have been developed bearing functional groups (aminodiacetate, phosphonate, etc.) which act as chelating agents fastly bound to the resin matrix. Sorption of anionic complexes onto anion exchangers (ammonium resins) provides another process in which metallic complexes are involved. A short survey on the physicochemical properties of the two chief chelating resins is presented. In the case of many molecular solutes a sorption process may be conceived involving complex formation with the counter ions inside of an ion exchanger. This is a very interesting extension of the application of ion exchange resin for molecular ligand separation. In numerous cases, high selectivities are attainable by means of such processes; easy and fast separations can be sometimes carried out without need of the chromatographic methods. As for separating mixture components of very similar behaviors, their use becomes necessary so that an optimal efficiency of the chromatographic methods may be obtained. (auth)

33518 RESEARCH IN CHEMICAL AND EXTRACTION METALLURGY. Proceedings of a Symposium held in Sydney, 24th–26th February 1965. Woodcock, J. T.; Jenkins, A. E.; Willis, G. M. (eds.). Monograph Series No. 2. Melbourne, The Australasian Institute of Mining and Metallurgy, 1967. 224p. (CONF-650225).

Twenty-nine papers presented at the symposium are included. Topics covered include: dispersed phase refining, hydrogen reduction of hematite single crystals, partial equilibria at interfaces, thermodynamic study of titanium–sulfur system, activities in silicate melts, self-diffusion and structure in molten chlorides, effect of ambient gas on liquid wustite density, formation of sulfates from cuprous sulfides, the system Cu–Fe–O, equilibria in the Pb–O–S system, mass transfer studies, heat transfer between flowing liquid metals and gas in porous bed, zinc reduction with air blast, zinc blast furnace slags, the Zn–Na–As phase diagram, decoppering lead with sulfur, recovery of manganese from slag, preparation of scandium metal, electrolytic reduction of alumina, metallurgical process development, mineral pulp mixing processes, hydrometallurgical recovery of molybdenum, dissolution of uraninites in sulfuric acid, production of UO_2 by hydrothermal reduction, electrolytic production of zinc, and precipitation of gold from cyanide solutions. Separate abstracts were prepared for 3 papers. (M.C.G.)

For abstracts of individual papers see: 33316, 33519, and 34021.

33519 KINETIC STUDY OF THE DISSOLUTION OF URANINITES IN SULPHURIC ACID. Laxen, P. A. (Government Metallurgical Lab., Johannesburg). Australas. Inst. Mining Met. Proc., No. 2, 181-92(1967).

From Symposium on Research in Chemical and Extraction Metallurgy, Sydney. See CONF-650225.

The rates of dissolution of uraninites from the Witwatersrand system and the Dominion Reef system and from Shinkolobwe (Congo Republic) are compared. The fine grained South African uraninites (–200 + 270 mesh) were mounted in briquettes and, after polishing, a "point count" procedure was employed to determine the exposed surface area of the uraninite. The briquettes were used in a kinetic study of the dissolution of uraninite in acid solutions at temperatures from 5 to 30°C. At 15°C the dissolution of the Witwatersrand uraninite in a solution containing sulfuric acid and ferric sulfate was twice that of the Dominion Reef uraninite and one quarter of the dissolution rate of the Shinkolobwe uraninite. Factors accounting for these variations in the dissolution rates are discussed. The rate of dissolution of uraninite increased with increases in Fe^{3+} concentration, and approached a constant level at higher Fe^{3+} concentrations. The reaction mechanism is postulated to be one of adsorption of Fe^{3+} on the uraninite surface, followed by a rate-controlling chemical reaction at the surface involving the adsorbed Fe^{3+}. Increasing H^+ concentrations (in the presence of 0.5 g/l. Fe^{3+} and constant SO_4^{2-} concentrations) first decreased, then, above about 15 g/l H_2SO_4, increased the dissolution rate. Increasing the SO_4^{2-} concentration in sulfuric acid–ferric sulfate solutions resulted in a relatively sharp decrease in dissolution rate. This decrease is attributed to the complexing of Fe^{3+} by SO_4^{2-} to form some less active sulfatoferric complex. The addition, under constant SO_4^{2-} concentrations, of $FeSO_4$ and of $MnSO_4$ each resulted in a decrease in dissolution rate. These decreased rates are attributable to competitive adsorption of the Fe^{2+} and Mn^{2+} ions with Fe^{3+} on the uraninite surface, and not to the lowered oxidation potential of the leach solution. Extremely low dissolution rates of uraninite were obtained in solutions containing perchloric acid–ferric perchlorate. Additions of SO_4^{2-}, and to a lesser extent Cl^-, to these perchlorate solutions increased the dissolution rate most markedly. These results indicated that the SO_4^{2-} anion was an essential group in the activated complex leading to a rapid oxidation and dissolution of uraninite by Fe^{3+}. Different dissolution rates were obtained with different oxidants. Exceptionally high dissolution rates were obtained with Ag^+, Hg^{2+}, Hg_2^{2+}, and MnO_4^-. It is suggested that the electronic configuration of these ions is the important factor in these high dissolution rates. Using Ag^+ as the oxidant silver metal precipitated at the uraninite surface, but did not interfere with the dissolution. This precipitation of silver metal promises to provide a means of identifying the reaction sites on a uraninite surface. With MnO_4^- as the oxidant the precipitation of MnO_2 at the surface reduced the dissolution rate to practically zero after a short period. (auth)

33520 DISTRIBUTION COEFFICIENTS FOR TWELVE ELEMENTS IN OXALIC ACID MEDIUM ON A STRONG ANION-EXCHANGE RESIN. De Corte, F.; Van Den Winkel, P.; Speecke, A.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 42: 67-77(July 1968).

The distribution coefficients were determined for twelve elements, namely As(III), Ce(III), Cr(III), Co(II), Cu(II), In(III), Lu(III), Mn(II), Hg(II), Mo(VI), Sc(III), and Zn(II), on a strong base anion exchanger in pure oxalic acid solutions. The K_D curves are given. A schema was developed for the chromatographic separation of five elements, namely As(III), Mn(II), Co(II), Zn(II) and Cu(II). Ce(III) can be separated from Lu(III). (auth)

33521 SOLVENT EXTRACTION OF SOME ACTINIDES AND FISSION PRODUCTS BY NITROMETHANE. Milic, Nikola B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Anal. Chim. Acta, 42: 160-2(July 1968).

The extraction of some actinides and fission products by nitromethane was investigated in order to study the possibility of separating Pu from these radionuclides. The dependence of the distribution coefficient of U(VI), Np(VI), Th(IV), Am(III), Cs, Ru, Zr–Nb, Sr–Y, and Ce(III) on nitric acid concentration in the aqueous phase was determined. The extractability of the actinides decreased in the order Pu(IV) > Np(VI) Pu(VI) > U(VI) > Th(IV) ≫ Am(III) while the fission products compared with Pu had the order Pu(IV) > Cs > Ru ≫ Zr–Nb, Ce(III), Sr–Y; thus Pu(IV) can be easily separated from Am(III), and, by multistage extraction, from Th(IV). The separation of Pu(IV) from Np(VI) and U(VI) can be carried out by converting Pu to the trivalent state. Pu(IV) can be separated from mixtures of Sr–Y and Ce(III), as well as from Zr–Nb and Ru by multistage extraction. The separation of Pu(IV) from Cs can be done in the same way as for U(VI) and Np(VI). (D.H.M.)

33522 SEPARATION OF AMERICIUM AND CURIUM FROM RARE EARTH METAL CARRIERS BY ION-FOCUSING ELECTROPHORESIS. Gee, H. Y.; Heimbuch, A. H.; Nathans, M. W. (Tracerlab, Richmond, Calif). Anal. Chem., 39: 98-100(1967).

The La (<0.5 mg) in the sample (containing ^{144}Ce as tracer) was precipitated as $La(OH)_3$ by adding aqueous NH_3, the precipitate was dissolved in the cathode solution (≃30 μl), and the solution was then applied evenly across a filter-paper strip. Anode solution (0.2N $HClO_4$) was applied to one-half of the strip and cathode solution to the other half. The treated strip was then submitted to ion-focusing electrophoresis for 25 min, with the current decreasing slowly from 20 to 10 mA. The activities were located autoradiographically by the method of Latimer et al., so modified that the sensitivity was enhanced ≃270-fold. Recovery of the activities was effected by dissolution of the bands in fuming HNO_3–$HClO_4$, followed by electrodeposition on platinum and counting. The effect of variables (migration time, concentration of acid in the anode solution, pH of cathode solution, c.d. and carrier concentration) on the separation of 0.2 mg of La from ^{144}Ce–^{144}Pr (≃10^4 counts per min) and ^{241}Am–^{241}Cm (≃310 counts per min) is reported. The average recovery was 77%, and the decontamination factor was high. (Anal. Abstr.)

33523 RESISTANCE OF RADON TO OXIDATION IN AQUEOUS SOLUTION. Flohr, Kathleen; Appelman, Evan H. (Argonne National Lab., Ill.). J. Amer. Chem. Soc., 90: 3584(June 19, 1968).

After a solution of $^{226}RaCl_2$ in $K_2S_2O_8$ stood for 23 days, less than

6% of the ^{222}Rn formed remained in the persulfate solution after argon was bubbled through it for 3 hrs, or after it was extracted with an equal volume of hexane. After the solution stood 38 to 39 days 80% of the radon could not be volatilized by argon bubbling and $^2/_3$ of it did not extract with an equal volume of hexane. The radon could be removed, however, by centrifuging in a clinical centrifuge. Attempts to oxidize radon with ozone and sodium perxenate resulted in solutions from which the radon could be removed either by bubbling in argon or by centrifuging. (D.H.M.)

33524 METHOD FOR SEPARATING URANIUM AND FISSION PRODUCTS BY THE USE OF BARIUM CHLORIDE. Ishihara, Takehiko (Japan Atomic Energy Research Inst.). Japanese Patent 1967-24631. Nov. 27, 1967. Filed Mar. 18, 1965.

By chlorinating spent nuclear fuel with a chlorinating agent other than chlorine gas, a mixed vapor of uranium and fission product chlorides is obtained. When the vapor is passed through a layer of barium chloride, the uranium chloride is absorbed in the layer, and most of the fission product chloride, having a high vapor-pressure, is passed through without absorption. The chlorine gas or a vapor containing chlorine is passed through the layer containing uranium chloride and the uranium chloride, absorbed as UCl_4, is converted into UCl_6. The latter is evaporated off the layer. (NSA of Japan)

33525 ELECTROPHORESIS OF RADIOELEMENTS IN MINERAL CHEMISTRY. Auchapt, J. M. (CEA, Marcoule, France). pp 257-66 of Chromatography and Methods of Immediate Separation. Volume II. Parissakis, G. (ed.). [Athens], Union of the Greek Chemists, 1966. (In French).

From 3rd International Congress on Immediate Separation and Chromatography, Athens. See CONF-650994-(Vol.2).

An electrophoretic, or electrochromatographic, method is described for the separation and determination of mineral ions of radioactive elements. The method is applicable not only to fission products but also to the analysis of traces by activation when the irradiation gives rise to several radioactive elements. (P.C.H.)

33526 PROGRESS IN WASTE-DISPOSAL RESEARCH AND DEVELOPMENT. Fineman, Phillip. Reactor Fuel-Process. Technol., 11: 107-16(Spring 1968).

Engineering demonstrations of solidification processes for high-level-activity waste, a radiant-spray calcium and melter, phosphate glass process, and solidified-product storage are described. Storage of calcined solids in salt mines is considered. Recovery of fission products by solvent extraction is discussed. Storage and treatment of waste solutions from reprocessing of zirconium alloy fuels and General Electric's Midwest Fuel-Recovery Plant are described. (52 references). (M.C.G.)

33527 VOLATILITY PROCESSES. Vogel, G. J.; Barghusen, J. J. Reactor Fuel-Process. Technol., 11: 101-6(Spring 1968).

The development of a fluidized-bed fluoride-volatility process for the recovery of uranium and plutonium from fuel elements is discussed. Fluorination of oxide fuels with ClF_3 is described. The Attila cell at Fontenay-aux-Roses, France, for volatility processing is also described. UF_6 handling procedures and container criteria are summarized. Fluorination of uranium compounds and properties of fluorides are considered. (36 references). (M.C.G.)

33528 COMPACT PYROCHEMICAL PROCESSES. Miller, W. E.; Steunenberg, R. K. Reactor Fuel-Process. Technol., 11: 96-100(Spring 1968).

Work on the salt-transport process for fast breeder reactor fuels is described. The process steps are demonstrated, process chemistry is discussed, corrosion of materials considered, and process equipment and kinetics are described. Processes for Molten Salt Breeder Reactor fuel are also discussed. Electrolytic processes are described. (15 references). (M.C.G.)

33529 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. Stevenson, C. E.; Paige, D. M. Reactor Fuel-Process. Technol., 11: 91-5(Spring 1968).

Factors affecting the acid dissolution of PuO_2, ThO_2, and of UO_2-Mo are discussed. The preparation of graphite-matrix fuels by grinding and leaching is considered. A ZrO_2-UO_2 compact is dissolved in fused ammonium bifluoride in preparation for acid dissolution and a process for decladding Zircaloy-jacketed UO_2 blanket material is described. A flowsheet using high concentrations of acid is proposed for extraction of solutions prepared from graphite fuels to overcome emulsion formation. (14 references). (M.C.G.)

33530 REACTOR AND FUEL-PROCESSING TECHNOLOGY. Volume 11, Number 2. Dutton, James J.; Lennox, David H.; Brown, Karl K.; Royal, Joseph; Gold, Raymond; Gregory, Paul H. (eds.). One of the Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Argonne, Ill., Argonne National Lab., Spring 1968. 46p. GPO $0.70.

A separate abstract was prepared for each of the seven sections. (M.C.G.)

For abstracts of individual sections see: 33526–33529, 35207, 35533, and 35534.

33531 EXTRACTION OF URANIUM(VI) FROM AQUEOUS OXALATE SOLUTION WITH HIGH-MOLECULAR-WEIGHT AMINE. Funaki, Koemon; Ishijima, Itaru (Tokyo Inst. of Tech.). Kogyo Kagaku Zasshi, 71: 339-45(Mar. 1968). (In Japanese).

A method was previously proposed for leaching of uranium(VI) from domestic uranium ores by using an aqueous mixture of bicarbonate and oxalate. The extraction and purification of the leached solution containing uranium(VI) and oxalate with amines (Amberlite LA-1 or LA-2) are described. It was found that, after acidifying the leached solution to a pH of about 1.5 to 2.5 by sulfuric acid, uranium(VI) was extracted very easily and efficiently with the amines. For example, the extraction coefficient for uranium(VI) was about 600 times, and the necessary amount of the amine was about one-half, as much as compared with those of the ordinary carbonate leaching solution containing no oxalate. In order to explain this characteristic phenomenon, the extractions of uranium(VI) and oxalic acid from the aqueous oxalic acid solutions, the extractions of uranium(VI) and sulfuric acid from the aqueous sulfuric acid solutions, and stoichiometric investigations of the extraction reaction were carried out. It became clear that this phenomenon can be explained as follows: uranium(VI) was extracted mainly as $R_2UO_2(C_2O_4)_2$ from the solutions containing oxalate, and as $R_4UO_2(SO_4)_3$ from the sulfuric acid solutions containing no oxalate. (NSA of Japan)

33532 ENRICHMENT OF ^{87}Rb BY COUNTERCURRENT ELECTROMIGRATION OF FUSED RUBIDIUM NITRATE. Saito, Nobufusa; Miyazaki, Akira (Tokyo Univ.). Denki Kagaku, 36: 137-42 (Feb. 1968). (In Japanese).

Rubidium-87 was enriched by countercurrent electromigration of fused rubidium nitrate using a "beaker-type cell" of quartz. The separation tube was made of Vycor glass, and was about 15 to 20 cm in length and about 4 to 9 mm in internal diameter. It was compactly packed with quartz powder and perpendicularly set in the beaker, which contained the fused salt at 360 to 380°C. A platinum wire was inserted into the upper part of the separation tube. Quartz frit was fitted at the bottom of the tube. An aluminum tube was inserted into the beaker as a cathode. When electromigration was started, rubidium ions migrated toward the cathode, that is, downward in the separation tube. On the other hand, the quantity of the salt was maintained nearly constant in the separation tube by force of gravity and permeability and thus countercurrent arose in the tube during electromigration. Since ^{85}Rb electromigrates a little faster than ^{87}Rb, the latter is gradually enriched toward the anode. The rubidium nitrate that adhered to the platinum anode was sampled every day and the isotopic ratio of rubidium in the sample was determined with an Atlas CH-4 mass spectrometer. After long runs of the electromigration, the separation tube was picked up, quenched, and cut to several pieces. Each fraction was quantitatively analyzed and the isotopic ratio of rubidium in each fraction was determined in order to examine the distribution of rubidium isotopes in the tube. Several electromigration runs were made. The most enriched sample was obtained after 18-day electromigration (mean electric current: 160 mA) and the isotopic ratio (^{85}Rb/^{87}Rb) was 1.80 (the natural isotopic ratio of the feed material: ^{85}Rb/^{87}Rb = 2.60). Besides a cylinder-shaped separation tube, a truncated-cone-shaped one was employed, and the use of the latter was found to be more favorable for the enrichment because countercurrent arises more easily and higher electric current density is available in the truncated-cone-shaped separation tube. If the enriched rubidium thus obtained is used, for example, as a "spike" for the isotope dilution method, rubidium may be determined with a precision of 1 to 3%. (NSA of Japan)

33533 EXTRACTION OF HYDROCHLORIC ACID AND URANYL CHLORIDE BY N-OCTYLANILINE. Mrnka, M.; Celeda, J. (Inst. of Chemical Tech., Prague). Chem. Zvesti, 22: 241-7(1968). (In Russian).

The extraction of hydrochloric acid and uranyl chloride by N-octylaniline was investigated. The equilibrium rate of uranyl chloride to N-octylaniline was found to be 1:3. By cryoscopic and viscometric measurement the dimerization of this salt in benzene was ascertained. Water determination in the extract, as well as the average polymerization degree revealed that uranyl chloride is extracted by anhydrous N-octylanilinium chloride trimere. (trauth)

33534 HOMOGENEOUS PRECIPITATION AND IGNITION OF ACTINIUM OXALATE. Butterfield, D.; Woollatt, R. (United Kingdom Atomic Energy Authority, Amersham, Eng.). J. Inorg. Nucl. Chem., 30: 801-5(May 1968).

A method is described for the purification of milligram quantities of carrier-free actinium by homogeneous precipitation of the oxalate. An investigation of the ignition of actinium oxalate is also described. (auth)(UK)

33535 EXTRACTION CHROMATOGRAPHY OF METAL SALTS. Stronski, I. (Technische Hochschule, Munich). Oesterr. Chem.-Ztg., 68: 5-19(1967). (In German).

A review is presented with special reference to the separation of the lanthanides and actinides. (267 references.) (Anal. Abstr., Vol. 15, No. 5, 1968)

33536 PRESENT STATE AND FUTURE PROSPECTS OF THE TREATMENT OF IRRADIATED FUELS IN SPAIN. Perez, Baldomero Lopez; Jodra, Luis Gutierrez (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid), 11: 430-7(Sept.-Oct. 1967). (In Spanish).

A brief history of the development of fuel reprocessing is given. A history of the Caliente M-1 plant is outlined, and its operational parameters are included. The CIES pilot plant is briefly described, and the construction status of the hot cell M-2 is outlined. Data on fuel elements from Zorita, Santa Maria de Garona, and the Hifrensa Spanish—French installation are tabulated. Future needs for fuels are discussed. (J.S.R.)

33537 EXTRACTION OF TETRAVALENT METALS WITH DI-(2-ETHYLHEXYL) PHOSPHORIC ACID. II. ZIRCONIUM. Tedesco, P. H.; de Rumi, V. B.; Quintana, J. A. Gonzalez (National Univ. of La Plata, Argentina). J. Inorg. Nucl. Chem., 29: 1307-15(May 1967).

The extraction of zirconium from sulphuric and nitric acid solutions by bis(2-ethylhexyl) ester of phosphoric acid (DEHPA) dissolved in kerosene was studied. Some equations are proposed to interpret extraction at different anion, hydrogen, and DEHPA concentrations. (auth) (UK)

33538 MIXING OF FLUIDS IN TANKS OF LARGE LENGTH-TO-DIAMETER RATIO BY RECIRCULATION. Harrell, James E. Jr. (Union Carbide Corp., Oak Ridge, Tenn.); Perona, Joseph J. Ind. Eng. Chem., Process Design Develop., 7: 464-8(July 1968). (ORNL-P-3519).

Measurements were made to determine the time required for mixing of miscible fluids, by recirculation, in tanks 4 and 6 inches in diameter and 15 to 40 feet long. The recirculation rate was varied from 2 to 100 gallons per minute. With a pulse input concentration, mixing times from 0.5 to 6.7 hours were required for the ratio of the completely mixed concentration to the maximum detectable concentration to reach 0.998. A theoretical method, using the axial-dispersed "plug-flow" model, was developed for predicting mixing times. Based on dispersion intensity data collected on one pass through the tanks, mixing times could be predicted fairly well (±20%) at circulation rates high enough to give Reynolds numbers greater than 10,000 in the tanks. At lower circulation rates, times predicted by using these dispersion intensity data were high. Predicted mixing times based on dispersion intensity data for straight pipes were normally too low. (auth)

33539 DYNAMICS AND CONTROL OF A BATCH REACTOR. Koppel, Lowell B. (Argonne National Lab., Ill.). Ind. Eng. Chem., Process Design Develop., 7: 416-21(July 1968).

Dynamics of a particular batch reactor are analyzed, using a pseudo-steady-state approach. The exothermic reaction involves separation of zirconium cladding from a highly enriched uranium fuel element by hydrochlorination in a gas-fluidized bed of inert solids. A practical stability criterion is derived and verified with experimental data. Control system simulation suggests that temperature control by manipulation of reactant feed composition is preferable to that obtained by manipulation of wall cooling. (auth)

33540 CALCULATION OF THE TRANSIENT BEHAVIOR OF SOLVENT EXTRACTION PROCESSES. Lowe, J. T. (E. I. du Ponte de Nemours and Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 7: 362-6(July 1968).

A method for calculating the transient behavior of countercurrent solvent extraction processes permits multiple feed and exit streams to simulate multicontactor cascades. Cocurrent mass transfer efficiencies represent nonequilibrium distribution behavior. Agreement between calculated and experimentally observed concentration profiles is good. The usefulness of the additional information obtained from transient calculations not available from steady-state calculations is described. This method can be used to optimize startup and shutdown procedures in nuclear fuel processing equipment. (auth)

33541 SEPARATION PROCESS OF THORIUM FROM RARE EARTH METALS. Saad El-Din Sherief, Mohamed K.; Almasy, Andor U. S. Patent 3,383,182. May 14, 1968. Filed Oct. 29, 1965.

The method for separating thorium from rare earths consists of forming a sulfuric acid solution of a mixture of thorium and rare earths using an excess of sulfuric acid so that the solution contains free sulfuric acid. A reducing agent selected from the group consisting of sulfur dioxide and hydrazine sulfate so as to convert cerium(IV) compounds present in the solution to corresponding cerium(III) compounds is added in excess. The solution is then passed through a strongly acid cation exchange resin and the thorium is recovered from the effluent. (P.C.H.)

33542 SOLVENT EXTRACTION OF SOME LANTHANIDES WITH 2,2,6,6-TETRAMETHYL 3,5-HEPTANEDIONE. Parlett, Henry Wisner. Columbus, Ohio, Ohio State Univ., 1967. 119p. Thesis.

The extraction from aqueous medium of praseodymium, samarium, europium, gadolinium, and terbium with 2,2,6,6-tetramethyl 3,5-heptanedione (dipivaloyl methane) as a chelating solvent was studied between pH 4.8 and 12.6. Solutions with an ionic strength of 0.1 at 24 ± 1°C and 2.5×10^{-5} M with respect to metal ion were used. Radioisotopes were utilized to measure the distribution ratios. A back extraction system starting with the chelate in the organic phase was used to improve the reproducibility of the data and to maintain a constant volume ratio. Forward extraction from the aqueous phase required precipitation of the hydroxide while adjusting the pH. All elements were essentially 100% extracted at pH values greater than 7. Equilibrium was attained in five hours shaking time. $pH_{1/2}$ values were determined and found to be: Pr – 6.2, Sm – 5.7, Eu – 5.6, Gd – 5.6, and Tb – 5.4. The solubility of dipivaloyl methane (DPM) as a function of pH was found to be 8.7×10^{-4} moles/liter up to pH 8.7 and increased to 3.0×10^{-2} moles/liter at pH 12.5. The variation of the log of the distribution ratio with pH can be explained by the presence of $M(DPM)_3$ in the organic phase and M(DPM), either $M(DPM)_2$ or M(DPM)(OH), $M(DPM)_3$, $M(DPM)_2OH$, either $M(DPM)_3OH$ or $M(DPM)_2(OH)_2$, and either $M(DPM)_3(OH)_2$ or $M(DPM)_2(OH)_3$ in the aqueous phase. It was not possible to differentiate between some species. Overall stability constants for the various species in the aqueous phase were determined using a least sum squares technique. Values for the first formation constant could not be accurately determined. Partition coefficients of the $M(DPM)_3$ chelates between DPM and water were determined and showed a slight increase from praseodymium to terbium. (Disser. Abstr.)

33543 DISPLACEMENT ION-EXCHANGE SEPARATION OF TERNARY RARE EARTH MIXTURES WITH CHELATING ELUANTS. James, D. B. (Michigan Chemical Corp., Saint Louis); Powell, J. E.; Burkholder, H. R. J. Chromatogr., 35: 423-9 (June 18, 1968).

The separation of a ternary mixture of rare earths by displacement cation-exchange chromatography with chelating eluants can be described by constructing a distance-time diagram. The original composition of the mixture and the separation factors are the only imputs to the calculation. The points of complete separation of each of the three components or the point of any partial separation can be determined. Two methods of operation are considered, viz. loading of the unchelated mixture prior to elution, and chelation of the mixture prior to its introduction to the resin. (auth)

33544 SELECTIVE PRECIPITATION OF CeO_2 FROM A Y^{3+}–La^{3+}–Ce^{4+} SOLUTION BY HEATING TO 210°C IN AN AUTOCLAVE. Yamaguchi, S.; Katsurai, T. (Inst. fuer Physik und Chemie, Tokyo). Z. Anal. Chem., 235: 179-80(1968). (In German).

CeO_2 could be precipitated from an aqueous solution of $Ce(NH_4)_2(NO_3)_6$ by heating to 210°C in an autoclave, while YCl_3 and $La(NO_3)_3$ were stable against this hydrothermal action. This method demonstrates the possibility of the separation of cerium from two other lanthanides. (M.C.G.)

33545 FISSION PRODUCT DECONTAMINATION BY URANIUM VOLATILIZATION WITH SULFUR HEXAFLUORIDE. Laser, M.; Merz, E. (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 11: 57-60(May 1968). (In German).

Sulfur hexafluoride, SF_6, reacts in the presence of oxygen at temperatures above 800°C with uranium and uranium compounds forming uranium hexafluoride. Under these conditions most of the other fission products are forming the respective fluorides. Molybdenum trioxide reacts partly to oxyfluorides. Ruthenium deposits partly as oxide and partly the pentafluoride is formed. Tellurium vapourizes as oxide without reaction with SF_6. By sublimation, the uranium hexafluoride may be decontaminated to a great extent. Only iodine and a part of molybdenum and technetium contaminate the uranium hexafluoride. For better purification a sorption-desorption-cycle, using sodium fluoride beds, is proposed. (auth)

33546 THE PROCESSING OF IRRADIATED FUELS IN SPAIN. Com. Naz. Energ. Nucl., Notiz., 14: No. 4, 57-9(Apr. 1968). (In Italian).

A description of the nuclear fuel reprocessing plant that entered into service late last year at Moncloa is presented. (auth)

33547 THE TRISAIA NUCLEAR RESEARCH CENTER. Com. Naz. Energ. Nucl., Notiz., 14: 63-112(May 1968). (In Italian).

The Trisaia Nuclear Research Center is located at Trisaia Inferiore in the Commune of Rotondella, Province of Matera. The area was purchased by CNEN in 1962 as a site for the plant now used for the reprocessing and remote-controlled refabrication of irradiated fuel, within the framework of the Uranium–Thorium Fuel Cycle Program (PCUT). The PCUT Program; the Center's general features; development plan, infrastructures, and general services; the ITREC complex (fuel processing and refabrication plant); and the Analytic Control Laboratories are discussed. At present the ITREC complex is the Center's principal facility, but further enlargements and expansions are planned. (auth)

33548 PROCESS FOR SOLIDIFYING RADIOACTIVE WASTES. (to Societe Europeenne pour le Traitement Chimique des Combustibles Irradies Eurochemic). British Patent 1,116,319. June 6, 1968. Priority date Apr. 7, 1966, Belgium.

A method is described for the solidification of radioactive wastes containing either water-soluble fluoride or a water-soluble mixture of fluoride and sulfate, with or without up to about 3 molar equivalents of nitrate for 1 molar equivalent of fluoride and/or sulfate. The first stage of the process consists of precipitating the fluorides and sulfates from the decladding solutions. The second and third stages of the process consist of distillation or evaporation of the water from the mixture until a paste containing 10 to 20% by weight of water is obtained, which is then allowed to harden to a dry cake. The leachability of the cake is reduced with an impermeable and insoluble material, which acts as a barrier between the cake containing the radioactive salts and the environment. (P.C.H.)

33549 METHOD OF CESIUM REMOVAL. Bonnin, Andre; Poirier, Philippe (to Saint-Gobain Techniques Nouvelles). British Patent 1,115,258. May 29, 1968. Filed Feb. 22, 1967.

A method is described for separating ^{137}Cs from radioactive effluents by passing the solution from which Cs is to be separated through a column loaded with a mixed ferrocyanide which has been previously adsorbed on a carrier. In one mode of the method, the ferrocyanide is adsorbed on an ion exchange resin. In a second mode, the ferrocyanide is incorporated in a glass fiber bed. The resin is then loaded with copper ferrocyanide and centrifuged after which a saturated solution of copper chloride is poured on. The resin is centrifuged and the excess copper is removed by washing with water. After drying, the resin is ready for the purpose of filling the column. (P.C.H.)

33550 URANIUM SEPARATION. El-Din, Kamel Saad; Almasy, Andor. British Patent 1,115,797. May 29, 1968. Priority date May 29, 1964, Hungary.

A method is described for the separation of uranium from a solution containing considerable quantities of Fe, Th, and rare earth metals. The method consists of preparing an aqueous solution of the chlorides of the metal containing a concentration of free HCl acid such that uranium is present as complex chlorine-containing anions, saturating the solution with SO_2, and absorbing the ions on an anion exchange resin. (P.C.H.)

33551 THE HYDROMETALLURGY OF URANIUM IN SPAIN. Jodra, L. G.; Josa, J. M.; Perarnau, M. Energ. Nucl. (Madrid), 11: 516-28(Nov.-Dec. 1967). (In Spanish).

The results obtained in Spain in the treatment of uranium minerals on laboratory, pilot-plant, and industrial scales are indicated. A description is given of the different ores studied and the results obtained in each step of the preliminary treatment, leaching (acid, alkaline, and static), solid-liquid separation (countercurrent extraction and centrifugation), uranium concentration (ion exchange and solvent extraction), precipitation, recovery of side products, and purification of concentrates. (tr-auth)

33552 SYNTHETIC INORGANIC ION-EXCHANGERS. PART I. SALTS OF CERTAIN POLYBASIC ACIDS WITH POLYVALENT CATIONS. Ionescu, T. D.; Tudorache, Gh. Rev. Chim. (Bucharest), 19: 90-3(Feb. 1968). (In Rumanian).

One of the shortcomings of ion-exchange resins is their relative lack of resistance; they suffer changes when exposed to temperatures higher than 150°C, to ionizing radiations and oxidizing agents. In order to improve these materials and broaden their applicability, the properties of the ion-exchanging zirconium, thorium, titanium, antimony, and tin phosphates, arsenates, vanadates, and borates were investigated. These insoluble salts are temperature and radiation resistant. In addition, the ion-exchanging properties of the oxides and hydroxides of iron, aluminum, titanium, zirconium, uranium, tungsten, tin, and bismuth were also examined, as these materials are used for the separation of radioisotopes and the decontamination of radioactive waste waters. It was concluded from the distribution coefficients that ^{106}Ru, ^{95}Zr, and ^{95}Nb may be easily separated from the other elements by means of tin phosphate; the same material may also be used for the separation of the pairs ^{89}Sr–^{137}Cs, ^{89}Sr–^{144}Ce, ^{137}Cs–^{144}Ce, and ^{90}Sr–^{90}Y. Acid uranyl phosphate is transformed by heating to 330°C into the orthophosphate; it has an exchange capacity of 2.5 milliequiv./g. The distribution coefficient for alkali cations on acid uranyl phosphate heated to various temperatures decreases with increasing temperature. (Review article, 55 references). (TTT)

33553 ISOTOPE SEPARATIONS BY CHEMICAL EXCHANGE. Laroche, Jean. Entropie, No. 21, 33-7(May-June 1968). (In French).

The isotopic effects appear in interchange reactions of the isotopes of the same atom which are involved in different combinations. For single molecules such as AX and AY, the exchange reactions may be written: $A_1X + A_2Y \rightleftharpoons A_1Y + A_2X$, A_1 and A_2 being the isotopes of atom A. Such reactions enable the enrichment of a molecule in a definite isotope and carry out isotopic separations in cascade. The separation procedures resort to two separate phases in countercurrent according to the conventional processes of fractional distillations. Where conversion of a phase into the other is easy, reflux columns are used according to so-called single-temperature system "monothermal." Where exchange cannot be carried out within a wide temperature range, dual-temperature operation "bithermal" is preferably used to avoid reflux columns. (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 33259 and 34318.

33554 (TID-24469) U. S. GEOLOGICAL SURVEY TRACER STUDY, AMARGOSA DESERT, NYE COUNTY, NEVADA. PART I. EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING, AND PRELIMINARY FINDINGS. Johnston, Richard H. (Geological Survey, Washington, D. C.). 1968. 69p. Dep. CFSTI.

A tracer study in the Amargosa Desert is designed to determine the velocity of ground-water movement through carbonate rocks underlying the Nevada Test Site and the Amargosa Desert. The site is underlain by lake deposits, alluvium, and basalt of Cenozoic age, and at greater depth by carbonate rocks of Paleozoic age. The rocks of Cenozoic age at the site range from 580 to 650 feet thick and consist of lake clays and sands, cemented alluvial gravels, a thin basalt flow, and tuffaceous sand. The rocks of Paleozoic age include brecciated dolomite (Bonanza King Formation) and coarsely crystalline, silty, generally unbrecciated limestone (Carrara Formation). The two carbonate units are Cambrian in age and are separated by a fault zone that is probably a low-angle thrust. This site is a part of several hydraulically interconnected valleys underlain in part by carbonate rocks of permeability higher than that of the overlying alluvium and the volcanic rocks. These carbonate rocks constitute a drain connecting the several valleys and the discharge area (a line of springs) in the Amargosa Desert. The site is about 7 miles from the spring line. As expected near a major discharge area, the water-level potential is higher in the carbonate rocks than in the alluvium; however, the head differential is small (less than 1 foot). Three exploratory holes, three tracer holes, and one sample hole were drilled at the site. The tracer and sample holes were cased through alluvium and volcanic rocks but were left uncased in the carbonate rocks. Exploratory hole 3, completed in alluvium, will be used as an observation well. The three tracer holes and the sample hole will be used for hydraulic testing to determine aquifer constants of the carbonate rocks and for tracer experiments to determine porosity and real velocities of water in the carbonate rocks. (auth)

33555 THORIUM ISOTOPES (^{230}Th, ^{232}Th) IN THE SURFACE LAYER OF BOTTOM SEDIMENTS FROM THE INDIAN OCEAN. Kuznetsov, Yu. V.; Simonyak, Z. N.; Lisitsyn, A. P.; Frenklikh, M. S. Geokhimiya, No. 2, 218-27(Feb. 1968). (In Russian).

Data on the concentration of thorium isotopes (^{230}Th, ^{232}Th) in the surface layer of various bottom sediments raised in the southern and central ports of the Indian Ocean were obtained. Peculiarities of the distribution of these isotopes on the bottom of the Indian Ocean have been revealed. Investigation of paragenetic associations of ^{230}Th and ^{232}Th with components of the chemical and granulometric composition of the sediments has shown that the deposition mechanisms of these isotopes substantially differ. (auth)

33556 FOSSIL ALPHA-RECOIL ANALYSIS OF CERTAIN VARIANT RADIOACTIVE HALOS. Gentry, Robert V. (Columbia Union Coll., Takoma Park, Md.). Science, 160: 1228-30 (June 14, 1968).

The distribution of alpha radioactivity in the vicinity of uranium and of certain variant radioactive halos in biotite was investigated by the fossil alpha-recoil method. Within the limits of the method, a previously proposed hydrothermal mechanism for the origin of certain variant halo types due to polonium isotopes could not be confirmed. (auth)

33557 THORIUM AND URANIUM CONCENTRATIONS AND ISOTOPE RATIOS IN RIVER SEDIMENTS. Scott, Martha R. (Yale Univ., New Haven). Earth Planet. Sci. Lett., 4: 245-52 (May 1968).

Sediments from five rivers in the eastern and southern United States have been divided into several size fractions and analyzed for thorium and uranium isotope concentrations. The ^{238}U decay series exhibits disequilibrium as a result of weathering. The ^{234}U/^{238}U activity ratio is less than unity in sediment derived from well-leached soils and greater than unity in sediment containing relatively large amounts of organic material from organic-rich surface layers of soil profiles. ^{230}Th exists in excess of equilibrium amounts relative to its parent ^{234}U in the fine fraction of most of the sediments analyzed. The thorium concentration and ^{230}Th excess are significantly higher in the 2 to 0.2 μ and less than 0.2 μ size fractions than in the 2 to 20 μ fractions, indicating adsorption by clays, complexing with sesquioxides, or possible concentration in resistates. Unsupported ^{230}Th is being added to deep-sea sediments at a maximum rate of 0.5 dpm/cm^2/1000 yr; therefore, detrital material is not a significant source of excess ^{230}Th in deep-sea sediments. (auth)

33558 ISOTOPIC COMPOSITION OF MODERN LEAD. Naydenov, B. M. (Kazakh Research Inst. of Mineral Resources, Alma-Ata, USSR). Geochem. Int. (Engl. Transl.), 4: 327-30 (1967).

Translated from Geokhimiya, No. 3, 372-6(1967).

The widely used lead isotope method of age determination depends on the availability of sufficiently reliable information on the isotopic composition of primary lead (i.e., lead coeval with the earth) and of modern lead. The isotopic composition of modern lead can be estimated only by statistical treatment of extensive data on the isotopic composition of lead from ores or rocks and extrapolation of the results. It was found that the intersection of isochrons drawn for leads from different igneous rocks of the USSR gives a point corresponding to the isotopic composition of the so-called modern lead. The data on the isotopic composition of lead characterize certain areas of the earth's crust, and the assumption that they represent average lead of the crust as a whole is arbitrary. A more objective estimate, based on statistical analysis of data on the isotopic composition of lead from numerous deposits, is presented. (R.C.K.)

33559 GAMMA-SPECTROMETRY OF GRANITIC AND METAMORPHIC ROCKS. Drescher-Kaden, Friedrich Karl. Ber. Deut. Ges. Geol. Wiss., Reihe B, 12: 29-48(1967). (In German).

Gamma ray spectrometry of radioactive rocks is used to clarify the petrogenetic processes determining the origin of the rock. (J.C.W.)

33560 TRACE ELEMENTS AND STRONTIUM ISOTOPES IN CARBONATITES, FLUORITES, AND LIMESTONES FROM INDIA AND PAKISTAN. Deans, T. (Inst. of Geological Sciences, London); Powell, J. L. Nature (London), 218: 750-2(May 25, 1968).

Carbonatites discovered in southwest Asia have typical trace elements, but some have unusually high ratios of strontium-87 to strontium-86. Related hydrothermal fluorites have quite different strontium isotope ratios and no distinctive trace elements, emphasizing difficulties in identifying ultimate sources of fluorites. (auth) (UK)

33561 INTERPRETATION OF GAMMA LOGS FROM UNDERGROUND BOREHOLES WITH THE AID OF SMALL COMPUTERS. Hartmann, Lothar; Henkel, Wolfgang. Z. Angew. Geol., 13: 212-18(1967). (In German).

A method is described for evaluating gamma-ray well logs recorded point-by-point, using the small automatic computer "Cellatron" Ser. 2b. Contrary to other methods it is operated on a purely numerical basis which makes it possible to use small computers. The principle and advantages of the new method are discussed. (Geophys. Abstr.)

33562 DIURNAL VARIATIONS OF THE EXHALATION OF Rn AND ITS CONCENTRATION IN THE ATMOSPHERE. Sen'ko, E. E. Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 4: 533-9 (May 1968). (In Russian).

The methods for measuring Rn exhalation were studied and discussed. Diurnal variations of exhalation of Rn and its concentration in the atmosphere were studied as a function of meteorological factors. A value for the turbulent diffusion coefficient is estimated for the inversion conditions. (tr-auth)

33563 APPROXIMATE PROBLEM FORMULATION IN SLOWING DOWN OF NEUTRONS. Kozachok, I. A. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, No. 4, 327-32(1968). (In Russian).

Equations used in neutron method of rock age estimations proved unsuitable for investigating hydrogenous media. A differential equation in partial derivatives was developed as an approximation for determining rock age. Appropriate initial and boundary value conditions are formulated. The equation obtained is valid in hydrogen containing rock studies. (auth)

33564 GEOCHEMISTRY OF URANIUM IN THE BALTIC SEA. Baturin, G. N. (Inst. of Oceanology, Moscow). Geokhimiya, No. 3, 377-81(Mar. 1968). (In Russian).

The content of U in the surface layers of sediments of the Baltic Sea varies from 1 to 4 × 10^{-4}% in the coastal deposits and from 5 to 20 × 10^{-4}% in deep-lying clay and silt-clay sediments. The distribution of uranium in the sediments of the Baltic

Sea is of the well-regulated type with distinct pelagic maximum. The concentration of uranium in the sediments and its distribution per surface was controlled by the content and distribution of the organic material. The hydrogen sulfide contamination of water near the ground, having a local and sporadic character, is not a basic factor in the concentration of uranium in sediments of this basin. One of the reasons for the low U/C_{org} relation in the sediments of the Baltic Sea is the low content, in comparison with other seas, of dissolved U in its waters. (tr-auth)

33565 THE CHELATION AND MOVEMENT OF ^{89}Sr–^{90}Sr (^{90}Y) IN A CALCAREOUS SOIL. L'Annunziata, Michael F.; Fuller, Wallace H. (Univ. of Arizona, Tucson). Contract AT(11-1)-947. Soil Sci., 105: 311-19(May 1968).

The influence of synthetic chelating agents on the movement of radiostrontium through soil with leaching was studied. Phosphomolybdotungstic acid (Folin–Ciocalteau Reagent) was found to serve as an excellent indicator for chelons, producing a blue color with the addition of Na_2CO_3. This color reaction was used in combination with paper electrophoresis to obtain experimental evidence indicating the presence of radionuclide-complexes in the soil solution as formed by the synthetic chelating agents. Movement and displacement of radiostrontium by EDTA, EGTA, DCyTA, HEEDTA, and DTPA were evaluated in columns of Mohave sandy loam soil. The displacement of ^{89}Sr from the soil columns was 19, 38, 44, 47, and 81 percent in the order: HEEDTA < DCyTA < EDTA ≤ EGTA < DTPA. Only 5 percent of the radiostrontium was leached out of the columns in the absence of synthetic Sr^{2+}-chelating agents. Radionuclides occurring naturally and possibly from fallout were leached from the Mohave soil with DTPA and constituted less than 0.2 percent of the radioactivity added to the soil. The profile distribution of sodium acetate-extractable radiostrontium remaining in the soil columns after leaching was most strikingly contrasted between the DTPA and the untreated columns. Trace amounts of radioactivity were detected in the upper centimeters of the DTPA-treated soil, whereas much greater amounts remained in the upper few centimeters of the control columns. The radionuclides existed as negative complexes formed by the synthetic chelating agents applied. Any natural organic chelating agents in the soil did not influence radiostrontium movement, nor did they influence chelation to any appreciable extent. (auth)

33566 FORM OF THE OCCURRENCE OF RADIUM IN PEAT. Titaeva, N. A.; Vlasova, E. V. (Moscow State Univ.). Geokhimiya, No. 3, 384-7(Mar. 1968). (In Russian).

Investigations using infrared spectroscopic methods showed that in humic acid and in insoluble residue, the sorption of Ra and Ca takes place in the form of ion exchange. The formation of non-exchange bonds for part of the Ra, sorbed on the insoluble residue, with working solutions of $CaCl_2$ can decrease the cementing of organic and mineral microaggregates and "sealing" in them of radium ions. The form of the occurrence of Ra in different composites of peat is determined by the ionic bonds and the presence of other alkaline earth elements. (tr-auth)

33567 ^{222}Rn EMANATIONS FROM A URANIUM DEPOSIT. Dyck, Willy (Geological Survey of Canada, Ottawa). Econ. Geol., 63: 288-9(May 1968).

The results of a preliminary survey of radon emanations in soil gas over a uranium ore deposit near Bancroft, Ontario, Canada are discussed. Soil gas samples were collected during the latter part of August. The radon emanating from the soil above the deposit was collected in one quart cans. A portion of the gas was transferred to an evacuated ZnS cell and its alpha activity counted. The significant features of the results were the fact that 90% of the radon values was greater than two times the background, but only 40% of the gamma radiation values was greater than two times the background. (R.C.K.)

Meteorology

Refer also to abstract 33562.

33568 (NUS–329) USERS MANUAL FOR CODE EXGAM: A CODE TO CALCULATE GAMMA PHOTON DOSE FROM AN AIRBORNE RADIOACTIVE RELEASE. Steyn, Julian J.; Kim, Y. S. (NUS Corp., Washington, D. C.). Nov. 1966. Contract SNPC-6. 56p. Dep. CFSTI.

A FORTRAN IV code–EXGAM–for use on a CDC–3600 digital computer has been written to predict the integrated photon dose at a receptor exposed to an airborne release of radioactivity. The code assumes the source spatial distribution to be Gaussian. Input options allow the user to choose source decay mode, cloud thickness, cloud wind speed, cloud stability class, cloud drift direction, air attenuation and build-up coefficients, and source photon energies. The code user's requirements and FORTRAN listing are given, along with a sample input and output. The code has been optimized with respect to computer execution time. (auth)

33569 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 48, JANUARY–MARCH, 1968. Taiki Hoshano Kansoku Seiseki, No. 48, 1-65(Jan.-Mar. 1968). (In Japanese).

The results of routine measurements of fallout radioactivity made during the period from January to March, 1968 are given. The fallout monitoring system is described. Methods for the collection of rainwater and dusts are outlined. Methods for measuring the radioactivity of the samples are discussed. Data tabulations are presented of the radioactivity measurements at several Japanese collection stations. (R.C.K.)

33570 STRATOSPHERIC–TROPOSPHERIC EXCHANGE BASED ON RADIOACTIVITY, OZONE, AND POTENTIAL VORTICITY. Danielsen, Edwin F. (Univ. of Hawaii, Honolulu). Contract AT(30-1)-3317. J. Atmos. Sci., 25: 502-18(May 1968). (NYO-3317-2).

Vertical cross sections of potential vorticity, computed and contoured by hand, and hemispheric distributions of potential vorticity, computed and contoured by machine, are compared to both discrete and continuous measurements of radioactivity made during Project Springfield. Comparisons made in the upper troposphere and lower stratosphere show a positive correlation between potential vorticity and radioactivity of stratospheric origin. The radioactivity measurements and machine-computed isentropic trajectories prove that stratospheric air from high latitudes is transported southward and downward into the troposphere as the tropopause folds. Changes in potential vorticity and the concentration of radioactivity along the trajectories also prove that subsynoptic-scale mixing destroys the extruded stratospheric layer in the troposphere. The mass outflow from stratosphere to troposphere associated with tropopause folding is compensated by a quasi-steady inflow along the tropopause. This inflow is necessary to maintain the large radioactivity gradients observed at the tropopause and to account for the observed mixing of stratospheric and tropospheric tracers on the stratospheric side of the tropopause. Tropospheric air entering the stratosphere at low latitudes with large values of potential temperature acquires radioactivity, ozone and potential vorticity by mixing in the stratosphere. Radiative cooling at high latitudes systematically moves the mixture to lower potential temperature levels in the cyclonic stratosphere, where the large-scale baroclinic waves transport it southward and the amplifying vortices fold it into the troposphere. (auth)

33571 STRATOSPHERIC RESIDENCE TIME AND INTERHEMISPHERIC MIXING OF ^{90}Sr FROM FALLOUT IN RAIN. Fabian, P.; Libby, W. F.; Palmer, C. E. (Univ. of California, Los Angeles). J. Geophys. Res., 73: 3611-16(June 15, 1968).

The ^{90}Sr fallout as measured in rain by the Health and Safety Laboratory worldwide network gives a stratospheric residence time of 1.6 years, which is in good agreement with the value from the direct measurements of the lower stratosphere by Project Stardust. The interhemispheric mixing time appears to be about 3.3 years. (auth)

33572 FALLOUT PARTICLES IN THE GROUND-LEVEL AIR FROM THE CHINESE NUCLEAR EXPLOSION OF DECEMBER 28, 1966. Yoshikawa, K. (Radiation Center of Osaka Prefecture, Osaka); Fujita, A.; Murayama, N.; Matsunami, T.; Mamuro, T. J. Geophys. Res., 73: 3637-41(June 15, 1968).

The daily fluctuation of the concentration of fallout particles in the ground-level air whose diameters ranged from 1 to 30 μ was observed for a period of about 3 months following the fifth Chinese nuclear explosion of December 28, 1966. It appeared that fallout particles larger than about 10 μ in diameter fell on the ground mainly by gravitational settling shortly after the explosion, and some smaller particles circulated with the air motion around the globe more than once. It was also found that about 20 days after the explosion the fluctuation of the particle concentration was rather well related to the variation of meteorological situations; the particle concentration decreased during periods of precipitation and increased during periods of high atmospheric pressure. (auth)

33573 FURTHER INVESTIGATION ON THE TRANSFER OF RADIOCARBON IN NATURE. Nydal, Reidar (Norwegian Inst. of Tech., Trondheim). J. Geophys. Res., 73: 3617-35(June 15, 1968).

The transfer of radiocarbon in nature is discussed. The box model is expanded to include ten reservoirs instead of the six. The reservoirs are the stratosphere, the troposphere, the biosphere, the mixed layer of the ocean, and the deep ocean in each hemisphere. Using some approximations, we have calculated the various exchange coefficients and have obtained more accurate values within the atmosphere. The exchange time between the stratosphere and troposphere varies with time, and the recent result of 2.0 ± 0.5 years is a better approximation for the first years after the radioactive injection than the previously reported value of 3.5 ± 0.8 years. Using available ^{14}C data from the ocean, we have attempted to calculate the exchange time between the atmosphere and the mixed layer of the ocean. Even though the last calculation is very approximate, there seem to be valid reasons to believe that this exchange time is between 5 and 10 years. (auth)

Mineralogy and Exploration

33574 DETECTING THE MIGRATION OF URANIUM AND ITS DECAY PRODUCTS IN MINERALS. Berzina, I. G.; Stolyarova, A. N.; Shimelevich, Yu. S.; Florev, G. N. Dokl. Akad. Nauk SSSR, 177: 1062-4(Dec. 11, 1967). (In Russian).

The methods of fission and alpha radiography are used for studying the migration of uranium and its decay products in minerals. In fission radiography, the spatial distribution of uranium is determined by special detectors which register the fragments emitted from the surface layer of the mineral during induced fission under the effect of neutron exposure. Alpha radiography is based on the use of special photographic plates for registration of α-particles emitted by radium and its decay products over a given contact exposure period. The past migration of uranium in the mineral is revealed by the spatial distribution of the tracks left by fragments from spontaneous and induced fission, and syngenic and postdepositional uranium are distinguished. Comparison of these data with those of alpha radiography reveals the motion of the uranium and its decay products in the given mineral. The tracks of spontaneous fission fragments which give the average pattern of uranium location throughout the existence of the mineral were revealed by treatment in a special etchant. The location of the uranium in the material at present was then determined by exposing the specimen to thermal neutrons and etching a second time. In this procedure, the tracks due to spontaneous fission are etched twice and thus show up more clearly than those due to induced fission. Migration of uranium was observed both from the mineral to the ambient medium and from the ambient medium to the mineral in specimens with various metasomatic histories. Since radium and all succeeding elements in the chain of decay products of the uranium family are not fissioned by thermal neutrons, comparison of the results of fission and alpha radiography for the same specimen reveals the distribution of uranium, radium, and thorium (when this last element occurs in appreciable amounts). Specimens of pitchblende, khlopinite, and uranite were studied. A-2 photographic plates were used for alpha radiography with an exposure time of 8 days. Lawson films were used as the fragment detectors in fission radiography. The specimens and detectors were exposed to thermal neutrons both unprotected and in cadmium containers. After exposure, the Lawson film was removed and etched (40% KOH, 30 minutes, 60°C). The A-2 plates and Lawson films were then compared on an MS-51 comparison microscope. It was found that the distribution of uranium and radium coincides in pitchblende and khlopinite, i.e., there is no migration of one element with respect to the other in these minerals. Nonhomogeneities of these two elements also coincide in some cases in uranite specimens. However, the results of this comparison in many cases indicate migration of uranium and its decay products out of the uranite and influx of materials with a high concentration of radium into the uranite due to metasomatic processes. (ATD)

33575 CONDITION OF IRIGINITE FORMATION. Karpova, L. N.; Zhiltsova, I. G.; Sidorenko, G. A.; Sgibneva, A. F.; Koroleva, G. I. Geokhimiya, No. 2, 166-72(Feb. 1968). (In Russian).

It was established that an acid medium (pH = 2.20 to 2.26), a temperature about 100°, and a substantial prevalence of uranium over molybdenum are optimum conditions of iriginite synthesis from uranyl nitrate and molybdic acid solutions. The stability maximum of iriginite, which was established by the method of dissolution, proves to be in the acid region of 3 to 6 pH for the natural mineral and about 2.7 for the synthesized. The synthesized iriginite is a monoclinic mineral with the $UO_2(HMoO_4)_2 \cdot 3H_2O$ formula. (auth)

33576 UNDERGROUND LEACHING OF POOR URANIUM ORES. Vecherkin, S. G.; Bakhurov, V. G.; Lutsenko, I. K. At. Energ. (USSR), 24: 128-33(Feb. 1968). (In Russian).

A new method for the extraction of uranium from poor ores is described. The basic reason for which a sufficiently high quantity of uranium in poor ores is not used and is left, is the absence of profitable technology for their processing. An economic analysis showed that the special extraction and processing of these ores in hydrometallurgical plants or by means of leaching collectively and in pits is not profitable. The cost of leaching uranium can only be reduced by its leaching on the site of occurrence. Test operations were made in mines in which there were worked out ores and which were closed down although there remained large quantities of uranium in the ores. The studies made were used to determine their kinetic regularities and to work out a method and regime for industrial underground leaching. In this method an ore mass was decomposed by drilling. The ores are stored in blocks and sprinkled with solvent. The uranium-containing solutions, passing through all stratum of ores, are accumulated at the bottom of the block and are led to the lower level, from where it is distributed by pumps to the surface for extended processing. The method of underground leaching makes it possible to conduct profitable processing of homogeneous and nonhomogeneous ores. (tr-auth)

33577 THE POSSIBLE APPEARANCE OF THE MIGRATION OF URANIUM AND OF ITS DECAY PRODUCTS IN MINERALS. Berzina, I. G.; Stolyarova, A. N.; Flerov, G. N.; Shimelevich, Yu. S. (All-Union Scientific Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). Dokl. Akad. Nauk SSSR, 177: 1062-4(Dec. 11, 1967). (In Russian).

The migration of uranium and of its daughter products in minerals was followed by rendering visible the structural defects caused by products of the spontaneous fission, using chemical etching agents, detecting the α emission of daughters, such as radium and by detecting the presence of fission fragments and activating them by neutron irradiation. Experiments with biotite specimens indicated that the introduced accumulations of uranium had a relatively low age level of about 20×10^6 years, while the age of the mineral was estimated at about 240×10^6 years. Such migration of the uranium was observed in a number of minerals subjected to the action of vapors, hydrothermal solution or metasomatism. Alpha radiographic tests with polished sections of pitchblende revealed that the spatial distribution of uranium and radium coincide in many cases, indicating that the two elements do not migrate independently from each other; on the other hand, in other cases as a result of metasomatism, the distribution patterns did not agree. (TTT)

Oceanography

Refer to abstract 33573.

Seismology

33578 (AD-662632) LARGE APERTURE SEISMIC ARRAYS (LASA). Quarterly Technical Report No. 1. (General Atronics Corp., Philadelphia, Pa.). Sept. 1967. Contract F19628-67-C-0370. 78p. (ESD-TR-67-615). CFSTI.

Four topics are discussed. The first is related to the high-frequency (4 to 5 Hz) portion of LASA seismograms. Data are cited which indicate a statistically significant amount of signal energy in this region, and preliminary unsuccessful efforts at combining high-pass filtered records from nearby seismometers are described. The second topic is the problem of the detecting underground nuclear tests in the presence of large natural events. A hypothetical detection system consisting of a number of single seismometers at close range and a continental-size array at teleseismic range is analyzed and discussed. The third topic is DIMUS processing of seismic array outputs. The conventional DIMUS processing consists of hardlimiting each seismogram (thereby yielding a one bit per sample representation) and then proceeding as with the unaltered seismograms. Two modified DIMUS schemes, which require a single analog channel, are considered. The performance of these schemes, conventional DIMUS, and conventional analog arrays is evaluated for the spectral-ratio and complexity diagnostics. Finally, an extended version of an automatic pP test is discussed. Initial calculations are presented that suggest that this test will yield satisfactory depth picks for earthquakes as deep as 150 km. (auth) (USGRDR)

ENGINEERING

Nuclear Explosions

Refer also to abstract 33578.

33579 (AD-661851) PREDICTION OF FIRE DAMAGE TO INSTALLATIONS AND BUILT-UP AREAS FROM NUCLEAR WEAPONS. EXPERIMENTAL STUDIES: APPENDICES A-G. Phase III of Final Report. Waterman, T. E.; Labes, W. G.; Salzberg, F.; Tamney, J. E.; Vodvarka, F. J. (IIT Research Inst., Chicago, Ill.). Nov. 1964. Contracts DCA-8; DA-49-146-XZ-021. 361p. CFSTI.

Experiments were performed to provide necessary data for the prediction of fire damage to urban areas exposed to a nuclear burst. The investigations dealt with: flame heights and burning rates of well-ventilated fires, fire spread within structures—model room experiments, fire spread from interior kindling fuels, fire spread from exterior kindling fuels, full-scale building fires and coalescence of convective columns from free burning fires. Detailed description of the employed instrumentation is given. The derived correlations as well as actual data are included. (auth)(USGRDR)

33580 THERMAL EFFECTS OF A NUCLEAR EXPLOSION IN SALT: THE SALMON EXPERIMENT. **Edwards, A. L.; Holzman, R. L. (Univ. of California, Livermore). Naturwissenschaften, 55: 18-22(Jan. 1968).**

The Salmon experiment was a nuclear explosion in the Tatum Salt Dome in Lamar County, Mississippi on October 22, 1964, carried out as part of the Vela Program. The explosion took place at a depth of 827.8 m, and had a yield equivalent to 5.3 ± 0.5 kilotons of high explosive, as estimated by radiochemical methods. A stable cavity formed, in the shape of a sphere with radius 17.4 ± 0.6 m, with a void volume 19,600 ± 1600 m^3, partly filled with a puddle of molten salt with a volume of about 2700 m^3. Several exploratory holes were drilled several months following the shot, including one into the cavity, through the puddle, and into the region below. The thermal effects of the Salmon explosion is summarized and a method of determining the yield of such an underground nuclear explosion from temperature measurements made in the region of the explosion at times from several months to years after the shot is described. The Salmon experiment provided an ideal case for investigating the accuracy of this method because of the data available on cavity geometry, thermal and physical characteristics of the rock, and cavity-gas temperatures for a period up to 18 months after the shot. Knowledge of thermal yield and temperature distributions is essential for planning subsequent uses of underground cavities or rubble regions formed by nuclear explosions. (auth)

Facilities and Equipment

Refer also to abstracts 33623, 35564, and 35730.

33581 (CONF-680426-1) URANIUM MILLING TECHNOLOGY: TRENDS IN FLOWSHEET DESIGN. Thunaes, A.; Colborne, G. F. (Eldorado Mining and Refining Ltd., Ottawa (Ontario). Research and Development Div.). [1967]. 21p. Dep. CAN.

From 70th Annual Meeting of Mining and Metallurgy, Vancouver, B. C.

When the Canadian uranium milling plants went into operation, flowsheets were utilized. Numerous process improvements have been made. Uranium milling technology is presented from the standpoint of a new mine operator charged with the responsibility for the design of an economic flowsheet, and indicate the range of process elements available and the testwork required to enable an intelligent decision to be made. (auth)

33582 (INR-870/XIV/PS) STANOWISKO DO BADAN MAKROSKOPOWYCH PREPARATOW RADIOAKTYWNYCH W KOMORZE GORACEJ REAKTORA EWA. (Facility for Macroscopic Observation of Radioactive Samples in the Hot Cell of the EWA Reactor). Bochenek, B.; Kasprzykowski, W.; Pracki, S.; Stanek, A. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 40p. (In Polish).

A test installation designed for macroscopic observations of radioactive samples (of 1000 Ci at 1.1 MeV), located in the hot cell of the EWA reactor, was developed and perfected. The assembly is composed of a monocular periscope, coupled to a remote control support, permitting displacements in three perpendicular directions. The periscope permits magnifying visual observations of 5, 7.5, 10, and 15 and picture taking at the scale 1×. (tr-auth)

33583 (ORNL-TM-1661) EVALUATION OF SLIDING SEALS FOR OPERATION IN DRY HELIUM. Abbatiello, A. A.; Neill, F. H. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 24p. Dep. CFSTI.

An evaluation was made of elastomer O-ring seals and chevron seals for piston ring and shaft seal service in a dry helium atmosphere with operating temperatures up to 350°F. Preceding tests had demonstrated that the combination of elastomer seals supported by polymer rider rings and lubricated with a dry-film lubricant could best meet the required service conditions. The present limited investigation was undertaken to define seal life, to determine the upper temperature limit on satisfactory seal performance for O-ring seals, and to determine the leakage from metallic and nonmetallic chevron seals. Conditions simulated were piston load, rubbing velocity, operating temperature, temperature cycles, and cylinder dwell periods expected during a full year of operation. The criterion of successful operation was that the total leakage past the piston and shaft seals during a test be no greater than the total volume displaced by the piston during the test period. At 350°F the O-ring seal combination performed adequately for its anticipated life. Limited tests on polymeric and metallic composition chevron seals indicated that they were not satisfactory for the present application without added development. (auth)

33584 (SZS-1/68, pp 21-34) METHODEN ZUR OBERFLAECHENDEKONTAMINATION IN RADIONUKLIDLABORATORIEN. (Methods for Surface Decontamination in Radionuclide Laboratories). Unger, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

For the practical use in radioisotope laboratories, recommendations are presented on the decontamination of radioactively contaminated surfaces. The recommended decontamination methods were selected for implementation using common chemicals and technologies. Provisional methods are described for skin decontamination. (auth)

33585 (TID-4103) ENGINEERING MATERIALS LIST: CUMULATIVE INDEX. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). June 1968. 104p. DTIE Free.

A cumulative subject and corporate author index that covers all packages of AEC engineering drawings and specifications announced in the Engineering Materials List (TID-4100 through TID-4100, Suppl. 42 dated December 1967) is presented. The index covers 1649 packages of engineering drawings and 10 packages of specifications. A title list of packages arranged in CAPE- and SP-number sequence is also included. (R.C.K.)

33586 (UCLA-12-640, pp 31-44) BIOPHYSICS. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

LEUKOCYTES— separation from blood
BLOOD SERUM— distribution of albumin macroaggregates in, of man, effects of size on
CELLS— organelles of, electron microscopic studies of, microvesicular body and transosome
ROOTS— growth of corn, effects of calcium on
RADIOISOTOPES— activity of, calculation of, as a function of time, computer method for
BLOOD— circulation measurements using, intravascular electromagnetic meter
BIOLOGICAL MATERIALS— separation of cellular, molecular, and subcellular particles from, electrophoretic (C.H.)

33587 ON-OFF X-RAY SOURCE. **Acree, E. H.; Case, F. N.; Dempsey, J. C. (to United States Atomic Energy Commission). U. S. Patent 3,387,136. June 4, 1968.**

A beta emitting gas is contained in a hermetically sealed system. The system consists of two chambers with a gas transfer apparatus connecting the two chambers. One chamber is unshielded and the inner surface is lined with a target material having a relatively high atomic number which emits secondary x rays when bombarded with beta particles emitted from the gas. This x-ray emission can then be turned off by transferring the gas into the second chamber which is shielded by a suitable shielding material thereby providing a simple and compact "on-off" x-ray source for use where size and simplicity of operation are of considerable importance, such as aerospace communications. (AEC)

33588 THE SERVOMANIPULATOR MASCOT III. **Com. Naz. Energ. Nucl., Notiz., 14: 58-9(1968). (In Italian).**

A new electronic servomanipulator, the Mascot III, was recently developed at Casaccia. The master slave units are pictured. The Mascot III differs from the Mascot I principally by its reduction in weight, decrease in inertia and friction, and improvement in fidelity. (J.S.R.)

33589 HIGH-POWER TEST GAMMA INSTALLATION. Dubodelov, G. M. Izmer. Tekh., No. 5, 95-6(May 1968). (In Russian).

An installation was designed for the control of γ dosimetric devices with energy from 50 to 500 FDZH (0.3 to 3 MeV) in a collimated beam. The method of testing is analogous to that used in the UPGD-1M device, but the testing possibilities are greatly expanded. (tr-auth)

33590 GLOVED ALPHA ENCLOSURE (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1731).
21 drawings.

An enclosure or glove box fabricated of steel and used to contain and manipulate α-active fissile materials in a slightly negative air atmosphere is described. The enclosure has a baked-on phenolic coating applied to all steel parts to provide corrosion resistance. Two gasket sealed doors are provided at each end of the enclosure for materials transfer. These openings may be fitted with bag-out ports for sealed transfer into and out of the enclosure. A large slant type window of Plexiglas provided with two 8 in. glove ports provides visibility and access to the enclosure. A centrifuge assembly is mounted on the floor and sealed to the enclosure. (For details see TID-4100 Suppl. 46). (F.S.)

33591 UNIVERSAL MOTION DEVICE FOR USE IN ULTRA-HIGH VACUUM. Caldwell, C. W. Jr.; Liebler, C. F. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Vac. Sci. Technol., 5: 90-1(May-June 1968).

A device having angular, linear, and/or rotary-motion drive for use in ultrahigh vacuum systems is described. All metal in the device exposed to the vacuum is type 304 stainless steel with the exception of the copper inserts. All fabrication was done by Heliarc welding. The manipulator has been used for crystal cleaning in a metal bell jar vacuum system operating in the 10^{-10} torr range. (R.C.K.)

33592 HEAT EXCHANGERS FOR AIR PREHEATING IN MHD CONVERSION POWER PLANTS. Borgese, Domenico; Fabre, Jean. Termotecnica (Milan), 22: 109-16(Mar. 1968). (In Italian).

One of the most important problems in the development of thermoelectric power plants with MHD conversion is that of preheating of the air. In order to obtain high yields it is necessary to furnish to the combustion system air with a temperature no lower than 1400°K. Two different preheating cycles are studied: one heats the air by means of an auxiliary combustion in such a manner that the air heated is stripped of impurities; the other uses the heated gas from the converter for the preheating of the air. This gas from the converter can have a high quantity of K, used as additive to assure in the converter a sufficient ionization level. A special-type Cowper preheater, used in metallurgy, is considered for the air preheating. Studies under way on heat exchangers for air preheating are summarized. (tr-auth)

33593 INTEGRATED EMERGENCY POWER. Dunsmore, Chester L. Power Eng., 72: No. 5, 48-50(May 1968).

With regard to nuclear plants, there has always been a concern for emergency power. A major part of plant licensing is given over to questions about normal and emergency power. Even with nuclear plants, though, the first few were licensed on an ad hoc basis, with considerable variance in criteria and approach. The situation now is somewhat different, however, with general criteria specified and rather detailed criteria proposed as standard for all nuclear plants. Some of these rules are discussed, along with design and operational details; and the use of small turbogenerators (separate from the main machine) is shown to be an excellent way of meeting both normal and emergency auxiliary power needs. Some typical designs of auxiliary and emergency systems are discussed and a detailed design of station auxiliaries for a sodium-cooled fast breeder with three heat transfer (steam-raising) circuits is considered. Though the detailed design was made for a sodium plant, it may be adapted to other emergency power problems. (auth)

33594 AUTOMATIC DATA ANALYSIS FILM TRANSPORT (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1739).
2 drawings.

A film transport system is described which is capable of moving 70 mm perforated or unperforated film such as is used in nuclear event photography or large data storage machines. (For details see TID-4100 Suppl. 46). (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 35532, 35674, and 35730.

33595 (LA-3941) QUARTERLY STATUS REPORT ON THE SPACE ELECTRIC POWER R AND D PROGRAM FOR THE PERIOD ENDING APRIL 30, 1968. PART I. (Los Alamos Scientific Lab., N. Mex.). May 22, 1968. Contract W-7405-eng-36. 7p. Dep. CFSTI.

Construction techniques and heat transfer results for annular return heat pipes are described. Tests were run to determine axial heat flow rates using potassium and sodium as working fluids in SS heat pipes with SS screens with exit temperatures up to 800°C. Indium was tested as a working fluid in a Re heat pipe with a W screen at 1950°C for 1000 hr. Re and W were found to be soluble in indium. Silver was tested as a working fluid in a Re heat pipe with W screen at 2000°C for 373 hr. Interdiffusion between Re and W occurred on the inner surface of the heat pipe. An incomplete test was made using phenyl ethyl as a working fluid in a SS heat pipe. (L.C.L.)

33596 (SCL-DR-67-66) NUFF: A PROGRAM FOR THE NUMERICAL COMPUTATION OF COMPRESSIBLE FLOW FIELDS. Emery, A. F. (Sandia Corp., Albuquerque, N. Mex.). June 1968. Contract AT(29-1)-789. 86p. Dep. CFSTI.

A generalized Eulerian code for the computation of supersonic transient flow fields is described. The code is capable of analyzing two-dimensional plane and axisymmetric flow in cylindrical coordinates, two-dimensional plane flow in polar coordinates, and two-dimensional axisymmetric flow in spherical coordinates. Detailed instructions for the use of the code are given, and solutions to some typical problems are illustrated. (auth)

33597 POTENTIAL VORTEX FLOW ADJACENT TO A STATIONARY SURFACE. Kidd, G. J. Jr.; Farris, G. J. (Union Carbide Corp., Oak Ridge, Tenn.). J. Appl. Mech., 35: 209-15 (June 1968).

The equations describing the flow produced by the interaction of a potential vortex with a stationary surface are solved by means of similarity transformations. In previous attempts at solutions, use was made of the boundary-layer approximations (in which case no solution can be obtained) or a particular form was assumed for one of the velocity components. In this analysis, where the only restriction is that the flow be similar, solutions are obtained for tangential Reynolds numbers up to 4.75. The numerical method employed is based on a recently proposed technique for solving ordinary differential equations with asymptotic boundary conditions. (auth)

33598 STEAM VOLUME FRACTION IN TWO-PHASE FLOW. II. Michiyoshi, Itaru; Serizawa, Akimi; Mitani, Shinji. Nippon Genshiryoku Gakkaishi, 10: 238-43(1968). (In Japanese).

The steam volume fraction α of a two-phase mixture flowing upward under atmospheric pressure was measured in a vertical concentric annulus, with inner and outer diameters of 9.5 mm and 21 mm, respectively. Use was made of a capacitance-type void meter. The following correlation was obtained: $\alpha = 1 - \sqrt{[(1-x)^2]}/1 + K_x)$, where $K = \epsilon\ (\rho_1/\rho_g)\ V_0^{0.5} \exp(-2 \times 10^{-6}q)$ $\epsilon = 1.3$ (bubble flow), $\epsilon = 1$ (slug flow and annular flow), x is the steam weight fraction, (ρ_1/ρ_g) the density ratio of liquid to steam, V_0 the superficial velocity (m/s), and q the heat flux (kcal/m^2/hr). The experimental data obtained under high pressure by several investigators for various channel forms correlated very well with use of the formula $K = \epsilon\ (\rho_1/\rho_g)\ V_0^{0.5}$, where ϵ is the same as mentioned above. These correlations are very useful for predicting the steam volume fraction at various pressures below 2000 psia. (auth)

33599 PREDICTION OF CRITICAL HEAT TRANSFER IN WATER-VAPOR SYSTEM. Biasi, Luigi; Clerici, Giancarlo; Garriba, Sergio; Sala, Riccardo; Tozzi, Antonio. Termotecnica (Milan), 22: 99-104(Mar. 1968). (In Italian).

A correlation between burnout for circular channels and uniform heating is derived. The results are compared satisfactorily with experimental data. Non-uniform thermal flux is briefly considered. (J.S.R.)

33600 URANIUM MINERALIZATION IN THE BURRO MOUNTAINS, NEW MEXICO. Gillerman, Elliot (Univ. of Kansas, Lawrence). Econ. Geol., 63: 239-46(May 1968).

Uranium minerals are present in the Burro Mountains in two separate areas: the White Signal district and the Bullard Peak district. In the White Signal district secondary uranium phosphates occur principally in the upper oxidized portions of eastward-trending gold-bearing quartz pyrite veins, or in fractures in granite adjacent to such veins. Most concentrations are in the vicinity of northwest-trending high-phosphorus diabase dikes.

Exploration of the unoxidized portions of the veins is minimal and the character of primary mineralization is unknown, but it is believed that the concentrations of secondary uranium phosphates are the result of the oxidation of the veins, and the fixation of the uranium in the zone of weathering by phosphate resulting from the alteration of the diabase dikes. In the Bullard Peak district uranium occurs with nickel and cobalt arsenides and sulfarsenides in what are predominantly native silver veins. Old records from now inaccessible mines of the district indicate that the percentage of nickel, cobalt, and possibly of uranium may increase with depth. Within the veins, silver occupies the central portions, and the nickel and cobalt minerals, principally nickel skutterudite, are concentrated toward the margins. The uraninite also occurs in the outermost zones with nickel and cobalt minerals. It does not occur with the silver. The veins cut Precambrian crystalline rocks, but the ore is believed to be genetically associated with a nearby Late Cretaceous or Early Tertiary monzonitic intrusion. The uraninite is believed to have been emplaced during the last phases of silver and base-metal mineralization, or it may represent a second stage of metallization allied to fluorospar and gold mineralization of nearby areas. (auth)

Isotope Technology

Refer also to abstracts 35201 and 35355.

33601 (AI-AEC-12643) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 3. CERAMIC COATING PROCESS DEVELOPMENT AND EVALUATIONS. Smalley, A. K. (Atomics International, Canoga Park, Calif.). Mar. 15, 1968. Contract AT(29-2)-2338. 60p. Dep. CFSTI.

A particular large radioisotope heat source capsule design requires a standoff coating between the T-111 structural vessel and the Pt-10Rh oxidation-resistant cladding to prevent reaction of the two alloys for five years at 2000°F. Requirements for the coating are a dense, stable, adherent diffusion barrier. Application of the coating must not affect the T-111 substrate. Al_2O_3 coatings from 0.5 to about 3 mils thick have been deposited on T-111 test specimens measuring 0.37" in diameter and 1" long by a chemical vapor deposition (CVD) process. Coating temperatures ranged from 1750°F to 2200°F; the best coatings were deposited at 1950°F. X-ray-diffraction analyses show the coatings to consist predominantly (approximately 90 percent) of well-crystallized α-Al_2O_3. Metallographic examinations show the Al_2O_3 to be dense and adherent to the T-111 substrate. Microhardness indentations made in the T-111 immediately adjacent to the Al_2O_3 suggest some superficial contamination by a hardening impurity. The hardened zone usually extended only 4 or 5 mils into the substrate. Bulk chemical analyses show that all specimens were contaminated slightly with C, N_2 and H_2 during processing. The measured levels of these impurities are considered acceptable. The feasibility of applying high-quality coatings of α-Al_2O_3 to T-111 alloy has been demonstrated. A 0.5 mil flash of tungsten, applied by CVD to the T-111 prior to coating with Al_2O_3, was not shown conclusively to prevent hardening of the T-111 during Al_2O_3 deposition. Bulk chemical analyses showed that the W-flash substrates contained approximately the same level of interstitial atoms as those specimens without the W-flash. A few experiments to apply Al_2O_3 coatings by arc plasma spraying (APS) and sputtering did not produce coatings to meet the postulated requirements. Adherent coatings of Al_2O_3 were applied to a 1200°F T-111 substrate in an inert gas with minimal substrate contamination. The coatings were only about 20% alpha Al_2O_3 and contained some cracks. The sputtered coatings were very thin layers of amorphous Al_2O_3. (auth)

33602 (AI-AEC-12676) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC). Third Quarterly Progress Report, January–March 1968. (Atomics International, Canoga Park, Calif.). Apr. 22, 1968. Contract AT(29-2)-2338. 135p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program was established to develop the technology for an isotope fuel capsule capable of operating in a space environment at a surface temperature of about 2000°F for five years or more. Progress is reported on the design, fabrication, testing, and evaluation of a test capsule which will meet the operating requirements. Specifications for the manufacture of both the reference design capsule and test items required for the program are presented. The following accomplishments are reported: reports were issued on materials specifications and ceramic coating process development and evaluation; a brazing procedure was developed for joining the Ta–10W pressure feed-through tube from the creep capsule to a SS pressure tube; the best heat treating cycle for the T-111 structural shell was identified; an electron beam welder for 100% penetration welds of the feed-through tube and the structural shell was installed and checked, and the resulting welds were examined by ultrasonic and metallographic techniques and found to meet the requirements; ultrasonic testing methods proved to be the best for determining defects in the weld joints; all tantalum and platinum alloy materials required for fabrication of the capsules was received. Tooling and process developments were completed, and two creep capsules were fabricated, assembled, and delivered for creep testing; the first of three creep test rigs was completed, and the first creep test is in progress; coupon compatibility tests to determine interactions of capsule materials in contact with each other were run at 2000 to 2500°F for 10 to 1000 hr. The results of electron beam metallographic analysis of one stack of materials after 100 hr at 2000°F are presented. (L.C.L.)

33603 (AI-AEC-12677) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 2. CAPSULE PROCESS SPECIFICATIONS. (Atomics International, Canoga Park, Calif.). Apr. 15, 1968. Contract AT(29-2)-2338. 116p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program for developing technology for high temperature (2000°F), long life heat sources (5 years or longer) which can be used in the space environment is described. The LRHSC program is specifically concerned with the development of a tantalum alloy fuel capsule. Data are to be obtained under conditions of biaxial creep, impact, and burial and include strain, compatibility, and thermal maps. The specifications which were prepared for key capsule processes are presented. Because of the necessity for full characterization of materials and hardware these specifications were prepared to reflect both program needs and technical capabilities. (auth)

33604 (BNWL-SA-1796) SOME PROPERTY MEASUREMENTS ON PROMETHIUM SESQUIOXIDE. Gibby, R. L.; Chikalla, T. D.; Nelson, R. P.; McNeilly, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 18, 1968. Contract AT(45-1)-1830. 31p. (CONF-680408-2). Dep. CFSTI.

From 70th Annual Meeting of the American Ceramic Society, Chicago, Ill.

Promethium-147 has nuclear properties which are desirable for isotopic power source applications; the sesquioxide of promethium is one of the fuel forms currently being evaluated. Properties which were measured in this investigation were melting temperature, thermal expansion, thermal diffusivity, and electrical resistivity. In addition, thermal conductivity was calculated from the thermal diffusivity data and estimated heat capacities. The decomposition of promethium(III) oxalate and formation of the oxide was studied by differential thermal analyses. Since promethium-147 transforms to samarium-147 through a beta-decay process with a half-life of 2.62 years, measurements were necessarily made on $Pm_2O_3-Sm_2O_3$ alloys, the samarium content being established by the decay time allowed prior to a particular measurement. Samples of Pm_2O_3, purposely doped with Sm_2O_3, showed large variations in melting temperature indicative of a wide solid plus liquid field. The thermal expansion behavior of a sintered sample containing 10 wt % ^{147}Sm was studied over the temperature interval 70 to 1030°C. The thermal diffusivity data to 1600°C for ^{147}Sm concentrations of 2, 12, 16, and 20 wt % were essentially identical. (auth)

33605 (WANL–3800-12) SNAP-23A, PHASE 1. Quarterly Progress Report, December 1, 1967–February 29, 1968. Henderson, W. B. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Mar. 15, 1968. Contract AT(30-1)-3800. 164p. (WANL-PR-SS–013). Dep. CFSTI.

Progress is reported on SNAP-23A, the Advanced Terrestrial Radioisotope Power System. Program management, including liaison work with suppliers and subcontractors, is discussed. Component testing for product assurance was continued. Systems design work progressed with emphasis on systems engineering, mechanical design, stress analysis, thermal analysis, thermoelectric analysis, design support for materials and processes, shield design, electrical design, and capsule design and development. Heat source materials properties evaluation tests were conducted to develop mechanical and physical properties, oxidation, and compatibility data for system design to permit 10 yr operation of the heat source. Base assembly testing will be conducted to evaluate insulation effectiveness of Min-K-2000 with a krypton backfill. A comprehensive safety analysis and test program has been drafted and is undergoing internal review. (R.C.K.)

33606 SOME ASPECTS OF RADIOISOTOPE GENERATOR FUEL PRODUCTION BY NEUTRON IRRADIATION METHODS. Zharkov, V. A.; Tereny'ev, V. P.; Fradkin, G. M. At. Energ. (USSR), 24: 348-51(Apr. 1968). (In Russian).

Some physical aspects of radioisotope generator fuel production by neutron irradiation are considered. A method of calculating self-shielding factors and flux-depression by reactor targets is presented. Some problems to be solved are outlined. (auth)

33607 ELECTRIC POWER IN SPACE. **Finger, Harold B. (National Aeronautics and Space Administration, Washington, D. C. Atomic Energy Commission, Washington, D. C.). Trans. N. Y. Acad. Sci., 30: 303-19(Dec. 1967).**

The development of systems for generating electric power in space is summarized. Such systems include batteries, fuel cells, solar cells, and nuclear reactors or radioisotopes that produce heat which may be connected to electric power. Radioisotope power systems used in navigation satellites, in which the heat generated by the isotope is directly converted to electricity in thermoelectric elements are described. The advantages and disadvantages of electric power systems for use in space are outlined. (R.C.K.)

33608 THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY RIPPLE PROGRAM. **Yeats, F. W. (Atomic Energy Research Establishment, Harwell, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Aerospace Electron. Syst. AES-3: 862-70(Nov. 1967).**

A review is presented of work carried out at the Atomic Energy Research Establishment since 1963 in the development of isotope-powered thermoelectric generators, known as RIPPLEs. The following topics are discussed: criteria for the selection of ^{90}Sr as the radioisotope, design of the generators, choice of material for the biological shield, development of the thermal insulation, the voltage conversion system employed, safety design considerations, effect of efficiency on the cost of generators, and typical costs curves. Of numerous possible applications of such generators, marine navigational lights appeared to be the most promising for early commercial interest, so that 2 prototype demonstration generators (RIPPLEs I and II) were developed in this context. These generators trickle charge Ni-Cd batteries from which a 0.2-J Xe flash tube housed in a small standard marine lantern is powered. Since March 1965, they have been operating continuously and satisfactorily, producing 75 mW. The UKAEA has a program to develop generators in the 100-W power range, and a 2½-W(e) generator (RIPPLE IV) is already under development for use in a submarine cable repeater. Various isotopes potentially useful as heat sources are considered. Strontium-90 was used for the first set of generators in the RIPPLE program. For the later RIPPLEs it was cold-pressed, sintered, and double-encapsulated in Delero-Alloy-C, giving a power density of 0.75 W/cm^3. Hot pressing may give higher power densities. The thermoelectric conversion system was chosen for the first phase of the RIPPLE program because of its more advanced stage of development than alternative conversion systems. All the RIPPLE generators except RIPPLE I use the microporous thermal insulation. Safety considerations are discussed. The safety design concepts provide that the isotope is in a chemically very stable form (preferably a ceramic); that the source is completely encapsulated and sealed by a material that is compatible with the isotope at its operating temperature and should remain sealed under any condition that may arise from a site hazard; and that the biological shield remain sufficiently intact to contain the isotope capsule under stress conditions. (BBB)

33609 RADIOACTIVE SOURCE COMPRISING A SHEET ARTICLE CONTAINING A LAYER OF SMALL DISCRETE RADIOACTIVE BEADS. **Haes, Donald L. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,376,422. Apr. 2, 1968. Filed July 15, 1964.**

An area radiation source is described that is handleable without dangerous radioactive material transfer to one's fingers, comprising a malleable and ductile metal substrate layer having a Brinell hardness number no greater than 75 at room temperature, and a compact monolayer of a multitude of discrete spheroidal elements between 5 and 250 microns in diameter pressed into the metal substrate layer to a partial extent at least equal to half the diameter of the elements. The spheroidal elements consists essentially of a hard and brittle spheroidal core containing radioactive material and a reinforcing concentric metal veneer plating between 0.2 and 5 microns thick and no thicker than about 10% of the diameter of the core. The metal of the veneer plating is less ductile than the metal of the metal substrate layer and more ductile than the brittle spheroidal core. The metal veneer plating has a Brinell hardness number at room temperature in excess of that for the substrate layer. The spheroidal elements are gripped laterally in the layer structure and held in the metal substrate layer by lateral compressive forces exerted by the metal of the substrate layer. The radioactive material is fixed in the cores of the spheroidal elements and the concentration of the spheroidal elements per square inch of the metal substrate layer being such that at least one microcurie of radioisotope per square inch of surface of the sheet article is present. (Offic. Gaz.)

33610 A LIQUID SCINTILLATION COUNTING TECHNIQUE FOR THE DETERMINATION OF THE MEAN FIBER DIAMETER OF WOOL SAMPLES LABELED WITH [^{14}C] FORMIC ACID. **Downes, A. M.; Till, A. R. (Commonwealth Industrial Scientific and Industrial Research Organization, Prospect, New South Wales). Text. Res. J., 38: 523-34(May 1968).**

A simple method of labeling wool in vitro with a known amount of ^{14}C was developed. Accurately measured volumes of a liquid scintillation solution, containing a small proportion of [^{11}C] formic acid, were added to the wool samples in counting vials. After the formic acid was absorbed by the wool, the counting rates of such samples depended on mean fiber diameter and on the degree of quenching of the scintillations. When the counter was operated at the appropriate ("balance-point") settings for each series of samples with the same degree of quenching, the counting rate fell linearly with increasing mean fiber diameter. Although the fall in counting rate was small, approximately 1% for a 1 μ increase in diameter, the results indicate that the accuracy of the method is sufficiently high to provide a new rapid method of measuring mean fiber diameter of large numbers of samples. An important advantage of the method is that the counting rate at the balance-point is independent of the presence of small amounts of vegetable matter. When vegetable matter is absent, the degree of quenching, which is measured simultaneously, is probably closely related to the yellowness of the wool and may, therefore, provide a useful index of this property. (auth)

33611 THE NUCLIDE GENERATOR. **Kjensli, Oddvar (Institutt for Atomenergi, Kjeller, Norway). Norsk Farm. Tidsskr., 76: 149-73(Apr. 1, 1968). (In Norwegian).**

Nuclide generators serve as continuous sources of short-lived isotopes and represent a convenient method of making some short-lived isotopes available at long distances from the producers. The principles of the different nuclide generator models now offered on the commercial market are described. For the system ^{99}Mo ^{99m}Tc a Norwegian nuclide generator was constructed and is routinely produced by the Isotope Laboratories at Institutt for Atomenergi, Kjeller, Norway. The construction and use of this nuclide generator is briefly described. (auth) (Norway)

33612 DESIGN AND DEMONSTRATION OF A RADIOISOJET. **Viventi, Robert Jr. (General Electric Co., Cincinnati); Isley, William C. J. Spacecraft Rockets, 5: 672-7(June 1968).**

The development and performance evaluation of a radioisotope-heated thruster for possible spacecraft application is described. A ^{147}Pm oxide capsule was used as the heat source in a nominal 20-mlb NH$_3$ thruster. The radioisojet mechanical design features were found to be quite similar to those for the thermal storage resistance jet. This permitted a parallel development and test program where the electrically heated thruster was constructed to the same physical dimensions as the radioisotope version. Initial and final testing of the electrically heated thruster was performed at General Electric Company. An interim 2-week continuous test program was performed at Mound Laboratory using both heater versions. Thrust, propellant mass flow, and temperature profiles were measured during these tests. The nominal 60-W(t) source produced core temperatures in excess of 1650°F at measured thrust levels up to 22 mlb. The corresponding specific impulse values were found to be greater than 230 sec for single-pulse operations having on-times up to 5 sec with thruster initially at nonflow steady state. A specific impulse of 152 sec steady state was demonstrated for continuous flow operation at 13 mlb thrust. There was excellent agreement in measured thrust and specific impulse for the electrically heated and radioisotope-heated thrusters at a rated power input of 60 W. Data correlated very closely also as a function of duty cycle and propellant flow rate over the range from zero to 100% on-time (i.e., continuous flow). Discrepancies in measured core temperatures between the two thrusters were attributed to location of sensing elements with respect to the heat source. Application of the radioisojet to a number of missions has been considered. Long-life, low-thrust applications, for which the power penalty must be borne by the auxiliary propulsion system, are attractive in terms of weight, reliability, and cost. (auth)

33613 RADIOACTIVE ISOTOPE METHOD OF REMOVING STATIC ELECTRICITY CHARGES. Romeikov, I. V.; Vladimirov, A. V. Poligrafiya, No. 1, 29-30(1965). (In Russian).

A ^{210}Po ($T_{½}$ = 138 days) alpha-source can neutralize a charge having a density of 2.4 × 10^{-9} coulombs/cm^2 on paper (assuming a maximum charge density of 2.6 × 10^{-9} coulombs/cm^2 on the paper). Beta sources of ^{147}Pm ($T_{½}$ = 2.65 yr) and ^{90}Sr ($T_{½}$ = 28 yr) are cheaper and have a longer half-life, but suffer from the disadvantage of a smaller air ionization, where a charge density >1.6 × 10^{-9} coulombs/cm^2 cannot be completely removed. The effect of changing the distance between the radioactive source and the charged material was investigated by placing a ^{147}Pm or ^{90}Sr source on one of two charged metal plates insulated from each other. The ionization current increased to a maximum at a certain optimum distance depending on the beta particle energy (about 50 cm for a 10 mc ^{90}Sr source). The source was placed at an angle of 80 to 90° to the charged surface, and it was found that the charge neutralization increased by a factor of 9 to 10 as compared to the case where the source was placed parallel to the charged surface. The beta sources were found to be equal to the best alpha sources in charge removal. (TTT)

33614 INFLUENCE OF THE MATERIAL GRANULATION IN BETA-BACKSCATTER STUDIES. Thuemmel, H.-W. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Isotopenpraxis, 4: 6-11(Jan. 1968). (In German).

The decrease of counting rate $K = (I_{P_r} - I_{P_u})/I_{P_r}$ in measurement of grained materials of uniform chemical (or elemental) composition (I_{P_u}) relative to that measured with pressed samples (I_{P_r}) of the same composition with plane smooth surface can be approached by $K = D_r/(1 + 2D_r)$, i.e., K is a function of relative grain size $D_r = D\rho/R$ only; D is the grain diameter, ρ the grain density, and R the maximum range of beta-radiation. For $D_r \approx 4$ is $K \approx 0.5$, for pressed samples $K = 0$. In measuring heterogeneous mixtures of two (or more) powders an inhomogeneity effect occurs which cannot be eliminated by pressing the samples and causes intensity losses similar to those due to the grain shape effect mentioned above. In a mixture with given grain sizes this influence of inhomogeneity is the smaller, the more equal to each other are the grain sizes of the powder components and the lower is the curvature of the backscatter factor curve (for elemental targets) vs atomic number. (auth)

33615 ISOTOPIC GENERATORS. Meriel, Yves. Sci. Progr.-Nature, No. 3395, 87-91(Mar. 1968). (In French).

Possible applications of isotopic generators are discussed with an indication of the requirements in each application. The direct conversion generators are only briefly considered as their yield is low and will probably never pass 10%. The most important dynamic conversion cycles are the Rankine, Brayton, and Stirling cycles. Each of these is described and illustrated, and the Stirling cycle is considered in detail. A schematic diagram is given of the Stirling–Philips motor with opposite pistons now under construction. The most ingenious and efficient SNAP generators are indicated. (J.S.R.)

33616 DEVELOPMENT AND RESEARCH WORK ON ISOTOPIC GENERATORS IN THE FEDERAL REPUBLIC OF GERMANY. Rosner, G. (Institut fuer Anorganische Chemie und Kernchemie, Mainz). Newslett. Isotop. Generator Inform. Centre, No. 5, 9-12 (Mar. 1968).

Efforts are concentrated on suitable conversion systems (able to transform the heat delivered by an isotopic heat source to an electric current) both for terrestrial and spatial applications. The conversion systems have been operated up to now with electrical heat simulating an isotopic heat source. Different stages of practical realization are reached in the fields of thermionic, thermoelectric, photoelectric and thermophotovoltaic conversion systems. (J.C.W.)

33617 INVESTIGATION INTO THE APPLICATIONS OF ISOTOPIC GENERATORS. PART VII. SUMMARY. Euler, J.; Scharmann, A. Newslett. Isotop. Generator Inform. Centre, No. 5, 13-23(Mar. 1968).

The technical characteristics of isotopic generators when produced on an industrial scale are ascertained. The characteristics of the prototypes were examined. These could be improved if it should prove possible to make the shielding lighter, to find more suitable radioisotopes, or to improve the efficiency of the energy conversion system employed. The outcome of technical development work on isotopic generators will depend not only upon the potential market, but to a great extent also upon the availability of the isotopes. (J.C.W.)

Materials Testing

33618 EFFECT OF POORLY UNIFORM THICKNESS AND SURFACE DEFECTS ON BURST TEST RESULTS OF FUEL CLADDING TUBES. Mishima, Yoshitsugu (Tokyo Univ.); Kondo, Yutaka; Takao, Zenichiro; Ono, Kenji; Seki, Yoshinobu. J. Nucl. Sci. Technol. (Tokyo), 5: 246-51(May 1968).

A study to evaluate and determine an acceptable defect level of fuel cladding tubes for light water reactors is discussed. The burst strengths of both Zircaloy-2 and AISI 304 L stainless steel tube were evaluated by burst testing naturally or artificially defected tube samples. It was found that the burst strength of Zircaloy-2 tube with nonuniform thickness is affected by the minimum thickness of the tube; a deep natural defect on the wall of the tube generally impairs the burst pressure value more than an artificially made defect of the same extent as determined by nondestructive testing; and artificial defects of depths up to 30% of the wall thickness do not cause appreciable deterioration of burst strength. (auth)

33619 IMPROVEMENTS RELATING TO THE DETECTION OF FLAWS IN DENSE MATERIALS. Metcalf, Arnold (to Plessey-UK Ltd.). British Patent 1,113,594. May 15, 1968. Filed July 13, 1964.

Flaws in dense materials, such as steel, are disclosed by exposing the material to neutron bombardment and detecting the neutrons as they emerge from the material by a directional neutron detector which comprises a number of scintillator elements. The scintillator elements may comprise a bundle of light guides coupled with an image intensifier and a fluorescent screen for viewing. (P.G.C.)

33620 NDT: IN THE THROES OF CHANGE [NEW NON-DESTRUCTIVE TEST METHODS]. Weld. Eng., 53: 36-40(Jan. 1968).

Developments in nondestructive testing by radiography including neutron radiography, magnetic particle inspection, penetrant testing, eddy current testing; and ultrasonic testing are reviewed. (J.R.D.)

Protective Structures

Refer also to abstract 33691.

33621 (AD-662749) SHELTER ENTRANCEWAYS AND OPENINGS. Final Report. Wiehle, Carl K. (Stanford Research Inst., Menlo Park, Calif.). Sept. 1967. Contract DAHC20-67-C-0136. 184p. CFSTI.

The objective of the investigation was to develop, test, and evaluate low cost shelter entranceways and openings for providing protection against the effects of nuclear weapons in the overpressure regions up to 20 psi. The approach adopted was to identify as many factors as possible that influence, limit, or constrain the entranceway design; to attempt to identify the multitude of interacting situations; and to establish the situations most important to the design of entranceways for civil defense shelters. From an examination of the numerous influencing factors, parameters were selected as the basis for performing cost analyses for various entranceway configurations. Cost estimates were then prepared for 36 individual entranceways and 2 escape exits. From these data, it was possible to develop the total construction cost of shelter entranceways for loading capacities up to 1,000 persons/min for six general types of entranceways applicable for civil defense fallout and blast shelters. Since the loading capacity required for a specific entranceway system cannot be determined in a general manner beforehand (as explained in the body of the report), the cost data are presented on the basis of the entranceway cost/person for shelter capacities up to 10,000 persons for the six entranceway types and for entranceway loading capacities between 67 and 1,000 persons/min. (auth) (USGRDR)

Radioactive Material Handling

Refer also to abstracts 33590 and 35463.

33622 (NP-17432) LA NOUVELLE LEGISLATION NUCLEAIRE FRANCAISE. II. LA RESPONSABILITE CIVILE DES EXPLOITANTS D'INSTALLATIONS NUCLEAIRES TERRESTRES. (New French Nuclear Legislation. II. The Civil Responsibility of Operators of Land Based Nuclear Installations). Demoures, M. Yves (Paris Univ. (France). Institut de Droit Compare). 1966. 25p. (In French). Dep.

The field of application of the legislation of Nov. 12, 1965, relative to the civil responsibility of the nuclear operator is defined. The characteristics of the responsibility on the operator are studied. The manner in which the victim of a nuclear accident can be indemnified is then outlined. (J.S.R.)

33623 (SZS-1/68) UEBER DEN BAU VON EINRICHTUNGEN ZUR RUECKHALTUNG RADIOAKTIVER ABWAESSER. (On the Construction of Equipment for Restraining Radioactive Fluid Wastes). Dagen, A. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jan. 1968. 34p. (In German). Dep. Includes an article by H. Unger.

The regulations concerning the protection of surface waters against contamination by radioactive wastes as contained in the Ordinance on the Protection Against Injurious Effects of Ionizing Radiations of the G.D.R. are described. Proposals made for the construction of delay tanks are discussed. (auth)

33624 PROCESSING OF RADIOACTIVE WASTE IN PETTEN. Smeets, L. (Reactor Centrum Nederland, Petten, Netherlands).

RCN (Reactor Cent. Ned.) Meded., No. 28, 115-23(1968). (In Dutch).

Waste water with low activity up to 15 mCi/day is drained by a pipeline extending 4 km into the North Sea. If necessary $Ca_3(PO_4)_2$ and $Fe(OH)_3$ are precipitated first. Low-activity solid waste is compressed and stored. High-activity material is stored underground in concrete containers. So far storage facilities outside the laboratory area have not been necessary. (J.J.t B.)

33625 PHYSICAL AND CHEMICAL CONDITIONS OF UNDERGROUND BURIAL OF RADIOACTIVE WASTES. Spitsyn, V. I.; Balukova, V. D.; Bagretsov, V. F. At. Energ. (USSR), 24: 133-6(Feb. 1968). (In Russian).

The basic complex of physical-chemical studies necessary for evaluation of the underground burial of liquid radioactive wastes was determined. The conditions for the burial of the deactivated wastes NIIAR were described. Rational technological procedures, guaranteeing the stability of the liquid phase during combination of the wastes with subterranean media, were established. The general conditions for the sorption of radioactive isotopes during burial in subterranean water in strata with high-mineral water content were examined. (tr-auth)

Vacuum Engineering

Refer also to abstracts 33591 and 33682.

33626 (IAE-1300) EKSPERIMENTAL'NYE ISSLEDOVANIYA KINETIKI SOROTSII VOZDUKHA V SOROTSIONNYKH SVERKHVYSOKOVAKUUMNYKH NASOSAKH S AZOTNYM OKHLAZHDENIEM. (Experimental Research into the Kinetics of Air Sorption in Nitrogen-Cooled Ultrahigh-Vacuum Sorption Pumps). Aref'ev, A. V.; Maksimov, S. P. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1967. 32p. (In Russian). Dep.

Experimental research into the kinetics of air sorption in nitrogen-cooled sorption pumps is described. The rates of air sorption for various sorbents at liquid nitrogen temperature and at various pressures are determined. It is shown that the rate of the sorption of air by various sorbents at low pressures is not a constant but decreases with increase in the amount of the sorbed air or gas. The effect of the cylindrical pump cavity on the rate of evacuation of air by sorbents is investigated and the optimal parameters of the cavity are determined. (auth)

33627 SCALING LAWS FOR EXPERIMENTAL DETERMINATION OF PUMPDOWN TIME IN THE MOLECULAR FLOW RANGE. Lewin, G. (Princeton Univ., N. J.). Contract AT(30-1)-1238. J. Vac. Sci. Technol., 5: 71-4(May-June 1968). (MATT-581).

The pumpdown time and ultimate pressure of a vacuum system cannot be accurately calculated since the gassing rates of the walls, which are the determining factor, are complex functions of time and pressure. Scaling laws are derived for dimensions of a scaled-down model of a large vacuum system made of the same materials which has the same pressure-time behavior. If a lumped volume of surface area A_1 is connected to a pump of speed S through a conductance C, the ratio $A_1(1/C + 1/S)$ must be kept constant. If the conductance C has a gassing wall of area A_d, the ratios A_1/C, A_d/C, and C/S have to be preserved. These results are generalized and the scaling laws are given for a system consisting of several lumped volumes with gassing surfaces connected in series through conductances with or without wall gassing. The same ratios apply in systems with local temperature variations if the same relative temperature distribution is maintained in both systems with the only change that the particle conductance C′ and particle speed S′ have to be substituted for C and S. The influence of wall thickness on the gassing rate is also discussed. (auth)

33628 GAS FLOW IN VACUUM SYSTEMS WITH LOCAL TEMPERATURE VARIATIONS FOR THE MOLECULAR FLOW RANGE. Lewin, G. (Princeton Univ., N. J.). Contract AT(30-1)-1238. J. Vac. Sci. Technol., 5: 75-8(May-June 1968). (MATT-570).

It is customary to measure gas flow Q in torr liter/sec and to calculate the pressure distribution in a system by using the relations $Q = C\,\Delta P$ and $Q = S\,P$ (C conductance, S pumping speed, P pressure). This requires that Q be the same everywhere in the system. If the temperature varies locally, Q varies also but the particle flow (molecules/sec) remains constant throughout. An analogous procedure based on the particle flow is proposed for systems with local temperature variations, and a particle conductance and particle speed are substituted for conductance and pumping speed. Examples are given to illustrate the method. (auth)

33629 HELIUM PUMPING WITH A SPUTTER-ION PUMP. Danielson, P. M. (Argonne National Lab., Ill.). J. Vac. Sci. Technol., 5: 89-90(May-June 1968).

Pumpdown tests were conducted on a sputter-ion pumped vacuum system coupled to a helium glovebox. The vacuum system, having been opened to air, was prepared for the pumpdown tests by evacuation to 2×10^{-11} torr. Twenty-four hours of pumping, including a 12 hr bakeout (250°C) cycle, were required. The test was conducted as follows: the evacuated system was backfilled with He; the system was re-evacuated with a trapped mechanical pump to $\sim 1 \times 10^{-5}$ torr; finally, the bakeable valve was closed and the sputter-ion pump started. The results of the tests are shown in graphical form. (R.C.K.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 35201.

General Detectors and Monitors

Refer also to abstracts 33688–33691, 35209, 35244, 35285, and 35333.

33630 (AD–663113) MEASUREMENT OF POSITRON ANNIHILATION INTERACTIONS WITH A Ge(Li) DETECTOR. Hotz, Henry P.; Mathiesen, James M.; Hurley, John P. (Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 15, 1967. 29p. (USNRDL-TR–67-127). CFSTI.

It was observed that the annihilation radiation photopeak in a Ge(Li) detector is considerably broader than that of a gamma-ray of the same energy. It seems reasonable to assume that the increased width is the result of the Doppler broadening of the annihilation photopeak, i.e., the longitudinal Doppler shift of the radiations is measured while the transverse shift is measured in the usual angular correlation experiments. By using a computer stripping program to remove the distortion produced by the finite energy resolution of the detector, momentum distributions are obtained which are in agreement with those which have been published. Only one detector is necessary for these measurements and all momenta channels are detected at once. However detector energy resolution severely limits the momentum resolution. Arguments are presented which indicate that no very large improvement in Ge(Li) detector resolution can be expected. (auth) (USGRDR)

33631 (AD–666543) A STUDY OF CHARGED PARTICLE TRACKS IN CELLULOSE NITRATE. Benton, Eugene V. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 22, 1968. 251p. (USNRDL-TR–68-14). CFSTI.

Both experimental and theoretical contributions are presented on the topic of dielectric charged particle track detectors. Cellulose nitrate was the principal track recording material. The study covers four areas: the chemical etch development of tracks; track registration criteria; range-energy calculations and comparisons with the etched tracks lengths; and charged particle detection. (USGRDR)

33632 (AD–666558) A DESIGN STUDY OF A LARGE APERTURE GAS THRESHOLD CHERENKOV COUNTER USING A WAVELENGTH-SHIFTER TECHNIQUE FOR LIGHT COLLECTION. Ball, Robert (Michigan Univ., Ann Arbor. Dept. of Physics). Feb. 1968. Contract Nonr-1224(23). 25p. (TR–31). CFSTI.

Using as a detection surface a POPOP-coated plexiglass sheet viewed by two 6810 phototubes, a He Cherenkov counter with 10 m. of He radiator and operating at atmospheric pressure at 14,000 feet can distinguish positive-pions from p in the energy range 30–140 GeV with an efficiency of at least 5% plus or minus 1%. The efficiency can possibly be considerably improved by the selection of photomultiplier tubes with optimum single photoelectron pulse height distributions and by optimizing tube voltages. Although a sample of positive-pion cosmic ray events can be labelled in spite of the small detection efficiency, unless the efficiency can be improved the event rate becomes almost prohibitively small. For Cherenkov counters used in accelerator experiments, the use of POPOP-coated plexiglass sheets for a detection surface has the following merits: A uniform efficiency for photons incident over a large area of arbitrary shape; a fast rise time provided through the use of photomultiplier tubes of small photocathode area, thus enabling the use of the Cherenkov counter in fast timing. (auth) (USGRDR)

33633 (AD–666659) GAMMA DETECTING–INDICATING SYSTEM, AN/GKQ-4. Technical Report, April 18, 1963–June 15, 1967. Clements, E. G.; Zielie, P. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Mar. 1968. 16p. (AFWL-TR–68-22). CFSTI.

The preliminary report describes the capabilities and operation of a prototype, wide-area, remote fallout monitor developed by the United States Air Force. This system is capable of detecting gamma intensities in a range of from 0.01 to 5000 R/hr, at up to 10 remote detecting locations, and transmitting this information by hard-line or radio telemetry to a single central location. The central station displays dose-rate information on individual meters and a single-strip chart recorder. An audio and visual alarm is given when a pre-set dose rate is reached. The system is able to operate on either 117 Vac, 60 Hz, or self-contained, rechargeable battery power in case of power failure. The final report will contain information concerning the development, design, and fabrication of this system. (auth) (USGRDR)

33634 (AD–665666) RADIOACTIVITY GROWTH–DECAY DATA: ANALYSIS BY APPLICATION OF THE LEAST-SQUARES METHOD. Yamamoto, Sachio; Brown, Mark (Naval Radiological Defense Lab., San Francisco, Calif.). Oct. 27, 1967. 46p. (USNRDL-TR–68-5). CFSTI.

The method of least squares has been applied to the analysis of growth-decay counting data and time-dependent gamma-ray pulse-height spectral data obtained from mixtures of genetically related nuclides. From the counting data, estimates can be obtained of the parent activity at the time of start of product growth and of the relative detection efficiencies (i.e., the total detection efficiency of one nuclide relative to that of another). From the gamma-ray spectral data, estimates can be obtained of the spectrum of each nuclide in the decay chain. (USGRDR)

33635 (AED-C–06-18) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 06. MESSINSTRUMENTE UND MESSVERFAHREN IN DER KERNPHYSIK. (Bibliographies in Nuclear Science and Technology. Section 06. Instruments and Measuring Techniques in Nuclear Physics). Debertin, Klaus (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Mar. 1968. 120p. (In English and German). Dep.

A list of 436 references on various instruments and measuring techniques used in nuclear physics is presented. The references were taken from NSA 20: 17–24. Also included are author and subject indexes. (W.H.K.)

33636 (AERE–M–2025) PROPOSED LOW-SIGNAL RADIATION DETECTOR INCORPORATING INTERNAL MULTIPLICATION. Gibbons, P. E. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 7p. Dep. CFSTI. UK 1s. 9d.

A proposed form of semiconductor detector for the measurement of photons and particles with energies of a few keV is described. The device, which also can act as an infrared photo-detector, utilizes avalanche multiplication. The effect of device parameters on gain and energy resolution is discussed. Ion implantation techniques will probably assist the practical implementation of this device. (auth)

33637 (CERN–68-14) EFFICACITE DE DETECTION DE DIVERS PHOTOTUBES POUR LA LUMIERE CERENKOV. (Detection Efficiency of Several Phototubes for Cerenkov Radiation). Duteil, P.; Garron, J. P.; Meunier, R.; Stroot, J. P.; Spighel, M. (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 24, 1968. 62p. (In French). Dep.

The relative value of the spectral sensitivity of photocathodes and the absolute value of the collection efficiency of photoelectrons were measured as a function of the wavelength of the incident light for different phototubes. An anomaly is shown in the form of the collection efficiency curves for phototubes in which the photocathode is sensitive up to the ultraviolet. The unexpected rise of the collection efficiency for $\lambda < 3000$ Å by the enrichment in soft electrons of the photoelectron spectrum is explained. This phenomenon is connected with the semiconducting properties of the Cs_3Sb layer. The form of the collection efficiency curves makes it possible to determine the threshold and the mean free path for the production of electron-hole pairs in Cs_3Sb by the primary photoelectron, whose energy is thus degraded. Totally, the appearance of this secondary effect can be interpreted as the production in the sensitive layer of two photoelectrons by the incident photon. It is shown that the probability of the simultaneous double emission outside of the curve is almost zero. The knowledge of this result is very important for the calculation of the detection efficiency of very low light pulses whose spectrum extends into the ultraviolet (Cherenkov radiation). (tr-auth)

33638 THE INFLUENCE OF DEVELOPMENT ON THE NUMBER AND APPEARANCE OF SILVER GRAINS IN ELECTRON MICROSCOPIC RADIOAUTOGRAPHY. Kopriwa, Beatrix Markus (McGill Univ., Montreal). J. Histochem. Cytochem., 15: 501-15 (Sept. 1967).

Under conditions similar to those in electron microscopic radioautography, the development of 3 different nuclear track emulsions (Ilford L4, Gevaert 307, and Kodak NTE) was investigated by varying the type of developer, duration of action, and temperature. These three factors influence: the number of silver grains produced from exposed silver bromide crystals and, therefore, the sensitivity of the emulsion; the production of a few silver grains from silver bromide crystals, unexposed to radiation from the specimen, that is, the background fog; and the size and shape of the developed silver grains, thus influencing the resolving power. The developed silver grains increase in number and in size with increasing duration of development. After complete development in most developers, the silver grains consist of highly convoluted silver filaments and are 2 or 3 times as large as the original silver bromide crystals. However, small grains may be obtained by brief development in Loveland's and P-phenylenediamine developers, in which case only development centers are revealed. Such small grain development improves resolving power, but decreases the number of developed silver grains, thus reducing sensitivity. (BBB)

33639 NEW TYPE OF REGRESSION OF THE LATENT IMAGE IN THE NUCLEAR EMULSION AT THE LIQUID-HELIUM TEMPERATURE. **Matvienko, V. I.; Petrzhak, K. A. Zh. Nauch. Prikl. Fotogr. Kinemotogr., 13: 132-3(Mar.-Apr. 1968). (In Russian).**

Tests with an α-detecting emulsion revealed that the track density at 4.2 to 1.5°K was much lower than at 300 and 76°K. This, previously described, phenomenon has been attributed to the temperature-induced reduction of the sensitivity. The results revealed that the density depends also on the time period elapsed between the completion of the irradiation and the start of the warming-up of the film. Similar observations were made with film sensitized with triethanol amine (TEA), and with unsensitized, fine-grain emulsion. As no latent image is formed at liquid-helium temperature, the observed phenomenon is not a true regression; the electrons are released directly from the trap and not from the silver atoms. As recombination of holes and electrons takes place at this temperature, the released electrons cannot participate directly in the formation of the latent image. Sensitization with TEA results in the formation of additional Ag^+ ions which react with the holes, forming silver halides and with electrons, forming silver atoms, thus reducing the probability of recombination and enhancing the growth of latent image centers. (TTT)

33640 IMPROVED METHOD FOR PRODUCING A SEMICONDUCTOR RADIATION DETECTOR. **Higatsberger, Michael J.; Hick, Harald Peter (to Oesterreichische Studiengesellschaft fuer Atomenergie Gesellschaft mbH). British Patent 1,115,939. June 6, 1968. Priority date Mar. 18, 1966, Austria.**

A method for producing a semiconductor radiation detector in which a monocrystal of the semiconductor material is bored through both the wall of the bore and the peripheral wall of the monocrystal are coated with electrode materials, one of which is or includes a doping substance, and an appropriate potential difference is applied between the coatings and maintained until diffusion of the doping substance is completed. (B.G.D.)

33641 DECAY OF A LATENT PHOTOGRAPHIC IMAGE IN AN ELECTRIC FIELD. **Samoilovich, D. M.; Ardashev, I. V. Dokl. Akad. Nauk SSSR, 179: 59-60(Mar. 1, 1968). (In Russian).**

Nuclear emulsions without support and with thicknesses ranging from 50 to 400 μ were exposed to charged particles, then subjected to the action of 10^3 to 8×10^5 V/cm pulsed and dc homogeneous electric fields, after which they were developed. In the dc field, dendrites consisting of photolytic silver were formed at the side toward the cathode. The depth of penetration of dendrites was greater in the developed layer than in the fixed but undeveloped ones, indicating that the silver which precipitated out in grains far from the electrodes was sufficient to form nuclei for development but not sufficient to destroy the grain. The low dielectric constant of the emulsion made it impossible to increase the dc field beyond 2×10^3 V/cm. Dendrites were also formed in the emulsions exposed to a pulsed field of $E \sim 10^5$ V/cm for at least 1 millisecond. The destruction of the latent image is attributed to the transfer of an electron of a silver atom of the latent image into the conductivity range of silver bromide; this is accompanied by the silver ion thus formed under the action of the field. (TTT)

33642 NEW RESULTS IN THE PARTICLE DETECTOR TECHNOLOGY. PART IV. SEMICONDUCTOR PHOTODETECTORS. **Nagy, Arpad (Central Physical Research Inst., Budapest). Atomtech. Tajek., 10: 567-78(1967). (In Hungarian).**

Continuing the review of the properties of photoelectronic multipliers from the viewpoint of noise, multiplication factor, and resolution, the most important achievements reached in the field of semiconductor photodetectors are examined. The solid state photodetectors based on the internal photoeffect may be divided into devices involving photoconductivity, photoelectromagnetic effect, and photovoltage. The small semiconductor diodes are well suited for constructing instruments with low noise and high time resolution. The resolution depends on the diffusion effect, the time of drift and scattering of the charge carriers and the capacity of the evacuated zone. Photodiodes may be prepared in point geometry, with small active volume, drift time and capacity, resulting in fast operational parameters, such as a frequency modulation of 50 GHz. The spectral sensitivity curves indicate that in the ultraviolet and visible range vacuum diodes or photomultipliers should be used; for the infrared range, germanium semiconductor diodes are recommended. (TTT)

33643 DEVICE FOR SENSING THERMAL NEUTRONS AND UTILIZING SUCH NEUTRONS FOR PRODUCING AN ELECTRICAL SIGNAL. **Treinen, R. L.; Stentz, R. H. (to United States Atomic Energy Commission). U. S. Patent 3,390,270. June 25, 1968.**

A thermal-neutron sensor that has the capability of providing a dynamic linear response to changes in thermal-neutron-flux conditions while providing an electrical output indicative of the density of the thermal-neutron-flux at the sensor is described. The sensor is formed of an emitter electrode possessing a high thermal-neutron absorption cross section for radiative capture of thermal neutrons and a collector electrode separated from the emitter electrode by a dielectric material. An (n,γ) reaction occurs in the emitter electrode upon sensing thermal neutrons for the generation of gamma photons which are absorbed to generate Compton electrons for collection by the collector electrode. (AEC)

33644 INVESTIGATION OF SCINTILLATION CHARACTERISTICS OF LITHIUM GLASSES BY DETECTION OF NEUTRON, β AND γ RADIATION. Gruzin, P. L.; Babikova, Yu. F.; Grishkin, O. E.; Samosadnyi, V. T.; Andreeva, N. Z.; Orlov, N. F. At. Energ. (USSR), 24: 177-80(Feb. 1968). (In Russian).

The results of the study of the dependence of the scintillation characteristics of lithium glass on the valency of the cerium, acting as the activator, were reported. It was established that the glasses containing the maximum quantity of Ce in the tetravalent state have the best characteristics as neutron detectors; their resolution is 20.5%. The scintillation developing during recording the γ radiation of ^{60}Co and ^{137}Cs and the β radiation of ^{28}Al and ^{32}P, and the conversion electrons of ^{137}Cs was investigated. It was found that the γ equivalent is 1.5 ± 0.03 MeV, the efficiency of the recording of the γ radiation of ^{60}Co in the range of thermal neutron beams is 0.22 to 0.25%. The comparative light yield of scintillation glasses during recording of neutrons is 20 to 30% of the light yield of scintillation crystals LiI(Eu). (tr-auth)

33645 CATHETER-TYPE SEMICONDUCTOR RADIATION DETECTOR AND ITS MEDICAL APPLICATION. **Ueda, Hideo; Iio, Masahiro; Sasaki, Yasuhito; Takayanagi, Sei-ichi; Kobayashi, Tetsuji; Sugita, Tohru; Saito, Katsuyoshi (Tokyo Univ. Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev., Int. Ed., No. 35, 44-9(Mar.-Apr. 1968).**

A catheter-type semiconductor detector which can be inserted into a living body has been developed. This catheter-type detector consists of a silicon p-n junction diode and has a maximum outer diameter of about 3.2 mm. The β activity from limited region of a living body has been successfully measured by this detector. Medical application of this detector includes the measurement of blood circulation time, detection of intracardiac shunt, continuous measurement of cardiac output, and diagnosis of malignant tumor. (auth)

33646 SOME PROPERTIES OF SILICON CARBIDE DIFFUSION COUNTERS FOR HIGH IONIZING PARTICLES. **Kholuyanov, G. F.; Gavrilovskii, B. V. (Leningrad Electrotechnical Inst. Kurchatov Inst. of Atomic Energy, Moscow). Fiz. Tekh. Poluprov., 2: 573-9(Apr. 1968). (In Russian).**

The properties of detectors, produced by diffusion of B in n-SiC crystals with specific resistance of 0.5 to 50 ohm · cm (20°C) were investigated in a wide temperature range. The substantial change of the capacity of the counter in dependence on the temperature and frequency is connected with the step structure of the potential barrier in the diffusion p–n transition, which can originate because of the presence in the n-SiC of some types of donors. Up to the sparkover voltage, the reverse currents of the detector at comparatively low temperatures can be explained by the incompleteness of the p-n transition. The noises of the counter during this regime do not exceed the noise level of the charge-sensitive preamplifier. The sharp increase of the noise level of the detector accompanies the beginning of the avalanche spark-over. At temperatures ≥500°C the determinative contribution to the reverse current of the counter gives thermal generation in the transition range. In this temperature range the maximum working voltage on the counter is limited by the current noise. The sensitivity of the signals on the counter during its heating from 20 to 400 to 500°C, found experimentally in a large number of samples, is explained by the corresponding increase of the lifetime of the current carrier. (tr-auth)

33647 POSSIBILITIES OF MEASUREMENT OF EXTREMELY LOW LEVEL β ACTIVITIES BY THE GAS-FLOW GM DETECTOR

IN 2π GEOMETRY. Zaduban, M. (Pavla Jozefa Safarik Univ., Kosice, Czech.). Chem. Zvesti, 22: 291-9(1968). (In Czech).

A gas-flow GM-detector in 2π geometry with absorption and anticoincidence shielding was used for measuring of extremely low activities of solid and liquid β-emitters. At 2.22 cpm background it is possible to take measurements of samples 50 mm in diameter. Maximum weight of the solid sample is 8 g, the volume should not exceed 4 ml. The calibrating was done by means of potassium salts (^{40}K). The minimum limit of the total activity for absorber thickness 20 mg/cm^2 is $0.9 \cdot 10^{-12}$ Ci. On the basis of the limit activity values achieved by ^{40}K it is shown the possibility of utilizing the known value of the total detection efficiency even for determination of the total activity of decay products β mixture old 150 days at least. The limit total activity of 100 mg/cm^2 sample for decay products mixture is $1.3-1.4 \cdot 10^{-12}$ Ci. (auth)

33648 CONSTRUCTION AND CHARACTERISTICS OF LITHIUM-COMPENSATED GERMANIUM DETECTORS. Cacheux, J.; Fertin, J.; Meuleman, J. Ind. At., 12: No. 3-4, 83-93(1968). (In French).

After a very brief summary of the interactions of electromagnetic rays with forms of matter, a listing is provided of the advantages obtainable by the use of monocrystalline germanium compensated by lithium. The properties of the p-i-n junctions resulting are then studied. The various techniques for the presentation of these junctions when cooled to a very low temperature are next examined, as well as the electronics involved, and the utilization of the signals furnished. Lastly, the prospect of a cell of universal conditioning is considered. (auth)

33649 X-RADIATION DETECTION DEVICE WITH MINIATURE Si(Li) SEMICONDUCTOR DETECTOR. Petushkov, A. A.; Meshcheryakov, A. B.; Pryakhin, Yu. F. Med. Radiol., 13: 47-9(1968). (In Russian).

The design and construction of an x-radiation detection device with miniature Si(Li) detector is described. The dependence of the detector current on the dose output of the x radiation at 50 keV and on the fine structure of the x radiation was determined and shown graphically. (J.S.R.)

33650 ALTERNATING COUNTING METHOD FOR LOW-BACKGROUND RADIATION MEASUREMENT. Yamakoshi, Kazuo (Kyoto Univ.). Jap. J. Appl. Phys., 7: 666-71(June 1968).

In order to obtain good statistics in low-background radiation measurements a fairly long counting time is necessary. Therefore the experimental accuracy depends on the gain stability of the counting system. A standard sample and a test sample are alternately measured for a certain interval, T, and finally the accumulated counts minus background counts for the respective samples are compared. Then it is expected that the effects due to the gain variations having time constants several times larger than T can be cancelled out from the ratio. By using a liquid scintillation counter system it is proved that there are suitable alternation intervals for the required experimental precision, and the distributions of the results obtained for these intervals are discussed. In the case of interval T = 200 sec, the observed results agree with the expected values in the precision of ±0.15% in a wide range of sample counting rate. (auth)

33651 STATISTICAL DESCRIPTION OF RANDOM PROCESSES AND THE SOLUTION OF INVERSE PROBLEMS ON COUNTERS WITH DEAD TIME. Shushurin, S. F. (Paris Univ.). Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 1, 3-9(Jan.-Feb. 1968). (In Russian).

An analysis was made of the possible approaches to the statistical description of random processes. As one of the possibilities, a method of description by means of the density distribution of the interval between adjacent events was introduced. In its framework it was possible to solve simply the inverse problem for counters with dead time, the value of which is arbitrary, but constant. (tr-auth)

33652 NUMBER OF CORRECTIONS IN THE METHOD OF ACTIVATION INDICATORS. Kopchinskii, G. A.; Klimentov, V. B.; Nikonov, A. V. At. Energ. (USSR), 24: 68-9(Jan. 1968). (In Russian).

Corrections due to self-shielding of the neutrons in a sample and perturbation of neutron flux by the sample are usually computed under idealized conditions, that is, for an isotropic flux of monoenergetic neutrons. Experiments were carried out with cadmium-shielded indium samples in order to determine these corrections under more realistic conditions such as in the presence of a strong absorber (90% enriched ^{235}U in disk form). The correction factors for the absorption of epithermal neutrons in the Cd shield were found to be (thickness of Cd in mm is given in parenthesis after the correction factor): 1.029 (0.3), 1.041 (0.4), 1.053 (0.5), 1.065 (0.6), 1.078 (0.7), 1.096 (0.8), 1.109 (0.9), and 1.120 (1.0 mm). Specific activities of the activated indium samples as a function of sample thickness were obtained by extrapolating the log of the activity to zero sample thickness. Gamma and beta readings of the activated sample were taken. Thus the corrections take into account neutron self-shielding, perturbation of the neutron field, and also self-absorption of radiation in the sample. Corrections are given for measurements in a mixed neutron spectrum and for indium irradiation in a Cd jacket 0.65 mm thick. The corrections for the harder neutron spectrum are greater than can be explained by strong resonance absorption of the indium. (TTT)

33653 MEASURING THE SCATTERED NEUTRON SPECTRUM NEAR A SYNCHROCYCLOTRON. Kimel', L. R.; Komochkov, M. M.; Sidorin, V. P.; Smirnitskii, V. N.; Sychev, B. S. At. Energ. (USSR), 24: 69-71(Jan. 1968). (In Russian).

The energy spectra of scattered neutrons were measured by means of nuclear emulsions at four places near the synchrocyclotron. The exposure time was 1 to 3 min due to the high background of gamma radiation (~1 mr/sec). The emulsion was rotated in two mutally perpendicular planes during exposure. The emulsions were scanned microscopically, and the proton recoil energy from the (n,p) reaction in the emulsion was calculated from the observed proton range. The neutron spectra were derived from the observed recoil proton spectra. The fast neutron flux decreased generally on going from the lower neutron energies to the higher neutron energies with a slight maximum being observed at ~3 MeV. The fast neutron flux varied from 1.2 to 5.0×10^4 neutrons/cm^2-sec at the four points of measurements, as determined by nuclear emulsion counts and activation of threshold detectors. (TTT)

33654 PERFORMANCE OF A HIGH SENSITIVITY LIQUID SCINTILLATION WHOLE-BODY COUNTER. Pringle, D. H. (Nuclear Enterprises, Ltd., Edinburgh). J. Phys., E, 1: 695-7(June 1968).

Comments are made on the paper by Barnaby and Jasani (loc. cit. 1: 91-8 (1968)) in which it is stated that organic liquid scintillators are so inflammable that their use in large volumes is not safe. Pringle states that he has used scintillator tanks containing thousands of litres of liquid scintillator in complete safety for many years. Barnaby replies that his statement was made in respect of hospital patient applications. Some comments are also made on the construction and performance of the counters, with replies by Barnaby. (UK)

33655 STUDY ON THE MEDICAL UNIVERSAL HUMAN COUNTER. (FOURTH REPORT). WHOLE BODY COUNTING BY LINEAR SCANNING. Hisada, Kin-ichi; Matsudaira, Masamichi; Kuranishi, Makoto; Mori, Shozo (Kanazawa Univ., Japan). Radioisotopes (Tokyo), 17: 242-6(June 1968). (In Japanese).

With the Medical Universal Human Counter (MUHC), whole body counting is obtained also by summing up the counts of linear scanning. For linear scanning, two detectors with a slit-field collimator are placed symmetrically above and two below the table. The table of the scanning bed is moved automatically along the longitudinal axis. The output signal is fed to a recorder through the ratemeter of the spectrometer. Isoresponse curves of this system in air and water were made with various measuring conditions. The most important thing in whole body counting is minimizing dependence of count on radioisotope distribution in the body. Whole body counting by linear scanning may bring the difference of ±30% to its maximum. But in clinical condition, the difference of counting was less than 5% despite considerable shift of radioisotope distribution in the body. About 10 μCi of ^{131}I in vivo can be measured with relative statistical error of 5% by linear scanning for 15 minutes. (auth)

33656 FAST AND SLOW NEUTRON COUNTER. Eberline, H. C. (to Eberline Instrument Corp.). Canadian Patent 783,126. Apr. 16, 1968.

A relatively simple, lightweight, portable instrument is described for detecting fast or slow neutrons, designed for operating at temperatures of 32 to 120°F even when immersed in water. An upper section houses a power source with detecting and amplifying circuitry. The lower section contains a Cd thermal neutron shield and a fast neutron moderator of paraffin. A removable BF_3 gas proportional tube, when mounted inside, measures fast neutrons. When removed, it measures slow neutrons. (F.S.A.)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 35315, 35335, and 35386.

33657 (AD-663268) VERSATILE, LARGE-MEMORY PULSE-HEIGHT ANALYZER FOR GAMMA-RAY SPECTROMETRY.

Euler, Bruce A. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 8, 1968. 20p. (USNRDL-TR-67-135). CFSTI.

A 16,384-channel pulse-height analyzer was designed and built to achieve maximum benefit from any of several special detection systems. Although the analyzer was intended primarily for coincidence gamma-ray spectrometry, broader usage potentialities were recognized so that, in the design, features were included which make this instrument useful for a variety of measurements in radiochemical and nuclear physics research. Some important features are: It can be used for the collection of either single- or two-parameter spectra, and provides for a wide selection of channel resolution in both applications; in collection of singles spectra, a series of spectra can be collected in rapid sequence, and each spectrum held in the memory until the entire series has been collected; a 16-position programmer makes it possible to specify a measurement sequence and to have it proceed automatically; an identifying block of words can be composed and optionally inserted directly into the analyzer memory; all or selected portions of the data can be inspected directly and easily; internal registers can be used for the selection of specific channels for display or for the summation of counts; punched-card and magnetic tape output options are available. (auth) (USGRDR)

33658 (AD-665977) TANGENT FOCAL PLANE THEORY AND CALCULATIONS FOR THE BROWNE-BUECHNER MAGNETIC PARTICLE ANALYZER. Warshaw, Stephen I. (Illinois Univ., Urbana. Dept. of Physics). Feb. 1968. Contract N00014-67-A-0305-0005. 32p. (TR-169). CFSTI.

First order focusing for the magnetic spectrometer of Browne and Buechner is discussed in the approximation where the focal surface is taken to be the plane tangent to the actual hyperbolic focal surface at the point for 90 degree bending. Expressions for magnification, dispersion, and related quantities are derived for arbitrary source-to-magnet distances, and compared with those for the hyperbolic case. Results of numerical calculations as applied to the University of Illinois 26 inch spectrometer are discussed. (auth) (USGRDR)

33659 (IN-1054) THE USE OF PROTON-RECOIL SPECTROMETER WITH PULSE SHAPE DISCRIMINATION FOR SPECTRUM MEASUREMENTS IN WATER MODERATED REACTORS. Powell, J. E. (Idaho Nuclear Corp., Idaho Falls). May 1968. Contract AT(10-1)-1230. 20p. Dep. CFSTI.

Proton and gamma ray rate-of-rise distributions were measured in the core of the Advanced Reactivity Measurement Facility II (ARMF-II) to demonstrate the feasibility of using a proton-recoil neutron spectrometer with pulse shape discrimination for spectrum measurements in a thermal reactor. A hydrogen filled proportional counter was used to obtain the data for proton energies over the range of 5 to 100 keV. A high residual gamma ray background present in the ARMF-II core prevented measurements below 5 keV. No gamma ray events were observed in the rate-of-rise distributions above 60 keV. (auth)

33660 TIME DEPENDENT FILTER FOR IMPROVING THE ENERGY RESOLUTION IN NUCLEAR SPECTROSCOPY WITH SEMICONDUCTOR DETECTORS. Schuster, H.-J. PTB Mitt., 78: 16-21(Feb. 1968). (In German).

A new time dependent filter is described for use as pulse forming circuit following a charge sensitive preamplifier in order to improve the signal to noise ratio for the spectroscopy of nuclear radiations. The signal to noise ratio can be increased by 31% using this filter instead of the RC-RC-filter (differentiating and integrating network in series). The optimal value following from information theory is approximated to a deviation of 3.7%. (auth)

33661 ONE VARIANT OF THE TECHNICAL DEVELOPMENT OF A COMPLETE ABSORPTION SPECTROMETER IN TESTS WITH COSMIC RADIATION. Koshumbekov, Kh. D. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 50-5(Nov.-Dec. 1967). (In Russian).

A chamber filled with mixtures of rare gases, the composition of which is close to the threshold of the chain ignition reaction, was proposed. The appearance of a sufficient number of oxygen atoms along the track because of the formation of electron avalanches is explained by the excess of the branching rate of cerium under its break, which must lead to the formation of point ignition foci along the particle tracks. (tr-auth)

33662 MODIFIED LEAST-SQUARES METHOD TO UNSCRAMBLE PROTON RECOIL SPECTRA. Kockum, J. (Swedish National Defence, Stockholm); Larsson, L. G.; Ebbsjoe, I. pp 269-76 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A computer program to UNFOLD proton recoil spectra has been written for the IBM/360-30 computer. By a least-squares technique it determines the neutron spectrum as weights in the sum of theoretically derived response functions when fitted to the measured recoil spectrum. Physically unreasonable oscillations, which easily result from this type of analysis, are depressed by adding a term γS_2 to the usual sum(S_1) of squared deviations before minimizing. Here S_2 is a measure of how well the points in the neutron spectrum fit polynomials of the k: th degree drawn through k + 2 points. k equals 2 or 3 has been used. The relative weights of the two sums are adjusted by means of γ. The program has been tested on pulse-height distributions obtained by calculations from a typical fast reactor neutron spectrum. The response functions used apply to a spherical proportional counter and take into account wall effects and counter resolution. It turns out to be possible to reproduce a neutron spectrum with the high cut-off neutron energy corresponding to proton ranges of the order of the counter radius. The program is also capable of correcting for proton pulses due to neutrons above the cut-off energy, provided that the shape of the neutron energy spectrum is known for these neutrons. In regions where the spectral variations are rapid compared to the counter resolution a smoothed result is obtained. It is found that the best reproduction of the original neutron spectrum is obtained for the γ-value which gives S_1 equal to the number of points in the recoil spectrum. An estimate of the statistical errors in the neutron spectrum thus obtained is given. A typical computing time for one γ-value is about 2.5 min when 53 neutron energy and 71 proton energy points are used. (auth)

High Energy Physics Instrumentation

33663 STATE-OF-THE-ART IN PATTERN RECOGNITION. Nagy, George (IBM Corp., Yorktown Heights, N. Y.). Proc. IEEE (Inst. Elec. Electron. Eng.), 56: 836-62(May 1968).

Statistical, adaptive, and heuristic techniques used in laboratory investigations of pattern recognition problems are reviewed. The discussion includes correlation methods, discriminant analysis, maximum likelihood decisions, minimax techniques, perceptron-like algorithms, feature extraction, preprocessing, clustering, and nonsupervised learning. Two-dimensional distributions are used to illustrate the properties of the various procedures. Several experimental projects, representative of prospective applications, are also described. (auth)

33664 SEARCH FOR OPTIMUM ELECTRIC PULSES TO OBTAIN TRACKS IN ISOTROPIC MONOGAP CHAMBERS. Cavalleri, G. (CISE, Milan); Cao, P.; Habel, R. Nuovo Cim., 55A: 829-33(June 21, 1968).

An experimental layout is described for optimal pulsing of an isotropic monogap chamber. Rectangular pulses and damped oscillating pulses were analyzed, and width, luminosity and brilliance of tracks and number of streamers per unit length were measured. (auth)

33665 AN ALGORITHM FOR REFINING THE PARAMETERS OF A PARTICLE MOVING IN A HYDROGEN CHAMBER, UNDER CONSIDERATION OF THE MAGNETIC FIELD INHOMOGENEITY AND DECELERATION. Filler, F. M. (Inst. for Theoretical and Experimental Physics, Moscow). Dokl. Akad. Nauk SSSR, 177: 1058-61(Dec. 11, 1967). (In Russian).

A relatively simple computer program was developed for determination of particle parameters in a hydrogen bubble chamber with a variable magnetic field, making allowances for the deceleration of the particles as a function of their mass. The precision reached was sufficient to apply the data to real chambers; the algorithm was used for handling the signals obtained in a 50-cm chamber with a 20,000-oersted field. The input data included the coordinates of a number of points on the track and the original approximation of the spiral-shaped particle trajectory. The calculation method is outlined and then applied to a concrete case. (TTT)

Radiation Dosimeters

Refer also to abstract 33778.

33666 (AD-661323) SILICON DIODE FAST NEUTRON DOSIMETER. PHASE II. ISOCHRONAL AND ISOTHERMAL ANNEALS OF THE RADIATION DAMAGE. Swartz, J. M.; Closser, W. H.; Thurston, M. O. (Phylatron Corp., Columbus, Ohio). Oct. 1967. Contract DA-18-035-AMC-101(A). 48p. (NRL-TR-83-2). CFSTI.

A discussion of the theory of annealing based on diffusion-limited processes is presented, along with the development of the characteristic equations for both monomolecular and bimolecular processes. A development of the theoretical dependence of the annealing characteristics on the chemical impurity concentration is also presented. Isochronal and isothermal anneals of the lifetime and forward voltage of p-i-n diodes, degraded by fast neutron bombardment, were performed over the temperature range from 23 to 200°C. The diodes were made from both n- and p-type, pulled and float zone material. Resistivities ranged from 50 to 1000 ohm-cm. The isochronal and isothermal results indicated that there are three dominant defects: one which anneals at room temperature; one which anneals in the 50 and 120°C temperature range; and another which starts to anneal above 120°C. All defects anneal with second-order kinetics. None of the defects seems to be associated with chemical impurities originally present in the material. (auth) (USGRDR)

33667 (AD-664758) EXPOSURE-RATE DEPENDENCE OF SELECTED GAMMA DOSIMETERS. Crimmins, Thomas W.; Gibson, Nancy N.; Pelletier, Armand M.; Jacobson, John R. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Jan. 1968. 25p. (NDL-TR-94). CFSTI.

The experiment studied the effects of exposure rate on the response of the following gamma dosimeters: silver-activated metaphosphate glass plates and rods, lithium fluoride and manganese-activated calcium fluoride microthermoluminescent dosimeters, and cobalt-activated borosilicate glass plates. Data were obtained in the exposure range of approximately 1,500 to 45,000 R at exposure rates from 5.2×10^{10} R/s to 2.2×10^{11} R/s. The results of this experiment indicate that no differences exist in the relative responses of the various dosimeters that may be attributed to exposure rate or to an interaction between exposure and exposure rate. No absolute exposure measurements were made, therefore data were analyzed on a relative basis. (auth) (USGRDR)

33668 (AD-661796) CHARGED PARTICLE TRACKS IN POLYMERS. NO. 5. A COMPUTER CODE FOR THE COMPUTATION OF HEAVY-ION RANGE-ENERGY RELATIONSHIPS IN ANY STOPPING MATERIAL. Henke, Richard P.; Benton, Eugene V. (Naval Radiological Defense Lab., San Francisco, Calif.). Oct. 3, 1967. 27p. (USNRDL-TR-67-122). CFSTI.

A computer program to generate range and stopping power tables is described. This program can be used to compute the range and rates of energy loss of any ion in any stopping material of known atomic composition over the energy interval 0.04 to 1200 MeV/nucleon. The program extends the generalized expressions of Barkas and Berger to lower energies by using the range data of Whaling and the range extensions for emulsion of Heckman, et al., and Henke and Benton. It approximates existing data well. Included are a flow chart, a listing of the Fortran IV coding, and sample output for comparison purposes. (USGRDR)

33669 (BNWL-741) CHARACTERISTICS OF TEFLON-LiF THERMOLUMINESCENT DOSIMETERS. Endres, G. W. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1968. Contract AT(45-1)-1830. 22p. (CONF-670115-2). Dep. CFSTI.

From 1st Health Physics Society Mid-Year Topical Symposium on Personnel Radiation Dosimetry, Chicago, Ill.

The characteristics of thermoluminescent teflon–lithium fluoride finger rings for personnel dosimetry are investigated. The discs require a minimum of handling, do not need processing before readout, and may be loaded in normal room light without inducing spurious readings. The relatively flat energy response eliminates the necessity for making large corrections when working with low energy radiation sources. And generally, the measurements are more accurate than those obtained using film. (W.H.K.)

33670 (BNWL-SA-1569) EFFECT OF ATMOSPHERIC TRITIUM ON PHOTOGRAPHIC, THERMOLUMINESCENT, AND RADIOPHOTOLUMINESCENT DOSIMETERS. Denham, Dale H.; Kathren, Ronald L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1968]. Contract AT(45-1)-1830. 12p. (CONF-680607-2). Dep. CFSTI.

From 13th Annual Health Physics Society Meeting, Denver, Colo.

^{7}LiF thermoluminescent dosimeters, in teflon or as extruded rods, low Z radiophotoluminescent glass, and personnel monitoring film were exposed to 1, 4, 40 and 200 MPC (5, 20, 200, 1000 μCi/M^3) of tritiated water in air at 52% relative humidity. Neither the TLD nor RPL glass dosimeters responded to the tritium over an exposure range of 4 to 4800 MPC-hours. Hence, these dosimeters cannot be used as atmospheric tritium detectors nor is protection required if they are worn by personnel in tritium contaminated atmospheres. Personnel monitoring film was affected by atmospheric tritium with the response per unit exposure being concentration dependent for exposure times below about 200 hours. The use of film as a tritium dosimeter is contraindicated unless tritium concentrations are reasonably constant or the exposure is made over a long period of time. A heat sealed pouch of 0.005 inch polyethylene will adequately protect the film badges of workers in tritiated atmospheres. (auth)

33671 (BNWL-SA-1836) FILM DOSIMETER PERFORMANCE CRITERIA AND AN ASSESSMENT OF CURRENT PERFORMANCE LEVELS. Unruh, C. M.; Larson, H. V.; Beetle, T. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 10, 1968. Contract AT(45-1)-1830. 14p. (CONF-680607-3). Dep. CFSTI.

From 13th Annual Health Physics Society Meeting, Denver, Colo.

A two-year study of personnel dosimeter performance capabilities and current levels of performance was recently completed. Thirty-five film processors participated in the study. The criteria to define performance levels based on current technical capabilities were formulated as a two-part performance specification. Specifications for both variance and bias were established. Equations to relate the performance level with the dose range of interest for ten types of radiations or combinations of radiations are presented. The range of variance and bias observed for commercial AEC contractors and military processors is presented and compared. (auth)

33672 DETERMINATION OF STRONG IONIZING RADIATION DOSES BY MEANS OF LiF THERMOLUMINESCENCE. Lyushina, A. F.; Shvarts, K. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 65-70(1968). (In Russian).

A thermoluminescence method using LiF crystals was developed for measuring ionizing radiation doses at 10 to 250 MRAD with the accuracy of ±10%. The temperature dependence of the highest intensity thermoluminescence peak was studied as a function of the dose. Dosimetric indices do not depend on doses up to 0.5 MRAD/sec. The use of powdered lithium fluoride may increase considerably the permissible critical dose value. The method is quite efficient and can be used for measuring powerful technical and pulsed radiation sources. (R.V.J.)

33673 NEUTRON DOSIMETRY FOR PERSONNEL MONITORING IN RADIATION PROTECTION. Narrog, J. (Landesinstitut fuer Arbeitsschutz und Arbeitsmedizin, Karlsruhe, Ger.). Atomwirt., Atomtech., 12: 443-7(Aug.-Sept. 1967). (In German).

In the German Federal Republic the 1st radiation protection regulation called for dosage measuring processes which permit the integrated dose to be directly determined at any and every instant. At present ionization chambers are the only known personnel dosimeters which fulfill this requirement. In the case of slow neutrons there is, for all practical purposes, no personnel monitor giving a continuous read-out although, in general, this type of radiation plays no part in radiation protection. A review is given of personnel dosimetry for dealing with neutron radiation from existing literature supplemented by experiments and experience from an official personnel monitoring station. The methods presently in use are described and newer developments are also briefly mentioned. The nuclear film stands out in the survey as the method most used at the present time. The use of nuclear films as dosimeters in the same sense as a gamma radiation dosimeter has little meaning in the case of reactors, accelerators and radioactive neutron sources since they represent only a qualitative method for the determination of fast neutrons. With reactors the essential part of the neutron dose equivalent falls in the medium fast region which the films do not cover. Similarly the same range of neutrons can be significant in the case of accelerators at places of importance outside the screening. With radioactive neutron sources the doses are generally low because of the limited neutron flux. Additionally in the case of reactors the technique is limited by the sensitivity of the nuclear film to the gamma rays which form the larger part of the personnel dose equivalent. A neutron dosimeter made up of strongly depleted uranium and plutonium as the fissionable foils and plastic or similar materials as the register foils covered on both sides with cadmium should in all cases overlay the nuclear film. (auth)

33674 LUMINESCENSE METHOD FOR DETERMINATION OF LEAKAGES IN NUCLEAR FACILITIES CONSTRUCTIONS. Zabelin, A. I.; Solov'ev, Yu. A.; Sokolov, I. N. At. Energ. (USSR), 24: 388-9(Apr. 1968). (In Russian).

Descriptions are given of a luminescence method for determining radiation leakage in nuclear power installations. The device operates with solutions containing photoluminescence materials which produce visible light after exposure to ultraviolet radiation. The procedures for determining irregularities in the welded seams of the BK-50 reactor vessel cover are described in detail. (R.V.J.)

33675 INSTRUMENTATION AND COMPUTER PROGRAM FOR THERMOLUMINESCENCE STUDIES. Prydz, Svein;

Skammelsrud, Kaare Sigmund (Univ. of Oslo). Phys. Norv., 2: 315-30(1967).

Instrumentation for study of thermoluminescence and related phenomena has been constructed and calibrated. The equipment comprises a temperature controller working in the temperature range 80–300°K. Several heating rates are available. Irradiation and measurement may be done in vacuum or in a suitable gas atmosphere. Both glow-curve registration and spectral measurements may be carried out. The spectral data may be obtained in a digital format directly useable for computer handling. A computer program has been developed which yields fully corrected spectra which may be sum spectra from many recordings. The mean spectral intensities are then given together with standard deviations. General trends from the construction of the equipment are given and the calibration procedure is discussed. Applications are reported in subsequent papers. (auth)

33676 OBSERVATIONS ON THE USE OF THERMOLUMINESCENT DOSIMETERS FOR GAMMA RADIATION. Corinaldesi, A.; Cecchetti, E.; Petralia, S. (Univ., Bologna). Radiobiol. Radiater. Fis. Med., 22: 306-12(Sept.-Oct. 1967). (In Italian).

Thermoluminescent dosimetry investigations were carried out using the γ rays of ^{60}Co. The problems of electronic equilibrium, and the use of various materials to prepare the containers for LiF were investigated. (auth)

Radiometric Instruments

33677 FLUCTUATIONS OF THE DETECTION THRESHOLD OF DYNAMIC ISOTOPIC RELAYS. Doerfel, G. (VEB Vakutronik WIB, Dresden). Isotopenpraxis, 4: 1-6(Jan. 1968). (In German).

Calculations of the statistical fluctuations carried out with respect to radiometric problems, in general, refer to steady-state operation or start from step-like influence of radiation when applied to isotopic relays. The fluctuations in the nonstationary phase are taken into account by using a more general point of view. The results obtained are presented for dynamically loaded, i.e., isotopic relays loaded not exclusively by a step-like function. (auth)

33678 RADIOMETRIC AZIMUTHAL PROBE. Krotovich, Yu.; Blashchak, Z.; Gradys, S. (Investigation Center of Geological Tech., Varshava, USSR). Isotopenpraxis, 4: 28-32(Jan. 1968). (In Russian).

A new measuring probe has been designed for studying the direction of underground water currents according to the single well method due to Mairhofer. The sensitive element of the probe consists of a metal- or glass-walled Geiger–Mueller counter built into a metallic tube together with the electronic circuits. The probe with GM counter has some advantages over those using other types of detectors. The investigations show that the probe is well fit for hydrogeological studies. (auth)

33679 INDUSTRIAL USES OF RADIOELEMENTS. Loverdo, A. Atompraxis, 14: 173-6(Apr.-May 1968). (In French).

Certain possible uses for radioelement calibrating devices (height, thickness, density) are explained in regard to ammonia production, refineries, and manufacturing inspection of glass tubes. Special equipment is described for radiometric weighing of atmospheric impurities, for observing the movements of the glass in tub furnaces, and for boron dosing by means of neutron absorption. (auth)

33680 BETA GAUGING LEAF WATER STATUS: INFLUENCE OF CHANGING LEAF CHARACTERISTICS. Mederski, H. J.; Alles, W. (Ohio Agricultural Research and Development Center, Wooster). Plant Physiol., 43: 470-2(Mar. 1968).

The use of β gauging as a method for continuous and non-destructive monitoring of the water status of plant leaves is discussed. In the course of determining the water saturation content of leaves of rapidly developing soybean plants (Glycine max), it was observed that the results for young, developing leaflets were significantly different from those for older, more mature leaflets. Because the leaflet must be removed from the plant to establish the calibration curve relating relative water content to β count rate, it is not possible to follow calibration transitions with the same leaflet each time. Factors that may affect β gauge calibration are discussed. It is pointed out that unless leaf area is known to remain constant, the calibration curve for a given leaf will be most reliable when empirically established by determining the count rate that corresponds with each of several values of leaf turgor or leaf water content covering the range of interest. (C.H.)

Miscellaneous Instruments and Components

Refer also to abstract 35728.

33681 (AD-665608) PULSE HEIGHT ANALYZERS: COMPUTER-COMPATIBLE OUTPUT FOR BOTH STATIONARY AND MOBILE SYSTEMS. Euler, Bruce A. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 23, 1968. 28p. (USNRDL-TR-68-4). CFSTI.

As the utilization of digital computer techniques for the analysis of pulse height spectra increases, it is important to develop efficient and reliable techniques for linking the pulse height analyzer to the computer. Two computer-compatible analyzer output media, punched cards and magnetic tape, were found to be practical and appropriate for providing computer coupling for an array of pulse height spectrometers which are used for making high-quality measurements in gamma-ray spectrometry. Both stationary and mobile installations were accommodated. An IBM-523 Gang Summary Punch, in conjunction with a specially built buffer unit, is used to provide fast punched card readout from 256-, 1024-, and 16,384-channel pulse height analyzers. Computer-compatible magnetic tape readout is provided on a 4,096-channel and a 16,384-channel pulse height analyzer. (auth) (USGRDR)

33682 (LA-DC-9000) DYNAMIC GAS FLOWMETER FOR ULTRA-HIGH VACUUM. Wilson, N. G. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 15p. (CONF-680401-3). Dep. CFSTI.

From 4th General Meeting on International Organization for Vacuum Science and Technology, Manchester, England.

For studying low flow problems such as gas diffusion in metals, a dynamic flowmeter capable of measurements at less than 10^{-5} torr-liter/sec is needed. A flowmeter system based upon known transmission characteristics of diffuser screens and associated pressure drops is being studied. An assembly of four axially mounted nude Bayard–Alpert ionization gauges and calibrated diffuser screens has been constructed. Initial tests of the device indicate that flows ranging from 3×10^{-4} to 3×10^{-10} torr-liter/sec can be measured. The assembly is constructed of electropolished stainless steel components, high-temperature feedthroughs, and nickel diffuser screens, and it is fully bakeable at temperatures up to 400°C. Characteristics of the flowmeter can be determined without absolute gauge calibration, since all pressure measurements are taken in terms of pressure ratios. Measurements of gas flows require calibration of at least one gauge in the flowmeter. By proper design and an initial known gas flow, calibration of all gauges in situ can be accomplished. (auth)

33683 (LFEN-NI.-30B) COMMUTATEUR AUTOMATIQUE DE GAMMES. (Automatic Range Switch). Menezes, J. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1966. 9p. (In French). Dep.

Also published as CEA report 1963/SER/1230.

An automatic range switch designed for use with a linear direct current amplifier for the reactor control is described. An automatic switch using a step-by-step motor is described in detail. Two other possible circuits are presented: one of the counting and computing type with several stable stages and the other of the sequential logic type. The step-by-step motor circuit offers an electro-mechanical solution. The second system uses solid state thyratron relays. The third circuit replaces the thyratrons with logic circuits. The advantages and disadvantages of each are discussed. (tr-auth)

33684 (ORNL-4217, pp 140-57) HIGH-RESOLUTION ELECTRON MICROSCOPY. Worsham, R. E.; Mann, J. E.; Richardson, E. G. Jr.; Ziegler, N. F. (Oak Ridge National Lab., Tenn.).

The development of high resolution electron microscopy in a new joint program between the Biology Division, Physics Division, and Electronuclear Division during 1967 is discussed. Topics include contrast and resolution, high-resolution microscope requirements, microscope design, regulated high-voltage supply, field-emission source, corrector lens, and microscope column development. (B.G.D.)

33685 (ORNL-TM-1638(Pt.30)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 30. HFIR TEST MODULE, ORNL MODEL Q-2630. Anderson, J. L. (Oak Ridge National Lab., Tenn.). Mar. 29, 1968. Contract W-7405-eng-26. 15p. Dep. CFSTI.

The HFIR Test Module is a special purpose module designed to supply signals for testing the response of parts of the safety system of the High Flux Isotope Reactor. The unit supplies calibrated current ramps of two different rates for checking the response and approximate calibration of both neutron flux level and rate-of-change-of-flux-level trips and associated signal amplifiers, adjustable steady-state test currents, and a circuit which continuously monitors ionization chamber polarizing voltage. The instrument is a standard plug-in module of the ORNL Modular Reactor Instrumentation Series. The circuit, application, maintenance procedures, and acceptance tests for the unit are described. (auth)

33686 (RISO-M-706) RELIABILITY OF PROCESS PLANTS AND INSTRUMENTATION SYSTEMS. Rasmussen, Jens (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb. 1968. 28p. (R-7-68). Dep.

The reliability of an instrumentation system is often regarded as a property that may be evaluated when the system has been designed on the basis of purely functional criteria. Elementary reliability properties of an instrumented system are discussed in an attempt to incorporate the reliability as a fundamental specification for the process control system proper as well as for monitoring and safety systems. (auth)

33687 (RISO-M-709) FAULT DATA FOR THE PREDICTION OF RELIABILITY OF ELECTRONIC AND MECHANICAL EQUIPMENT AND SYSTEMS. Timmermann, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb. 1968. 14p. (R-9-68). Dep.

Some component fault rate data are given and suggested to be used as the basis for reliability predictions during the design or planning of electronic and electromechanical systems. (auth)

33688 (ZfK-121) THIRD SYMPOSIUM ON NUCLEAR ELECTRONICS OF THE UNITED INSTITUTES FOR NUCLEAR RESEARCH AT DUBNA, OCTOBER 19-22, 1965 IN ROSSENDORF. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). 1966. 425p. (In German and Russian). (CONF-651093). Dep.

Separate abstracts were prepared for the four sections presented. (W.H.K.)

For abstracts of individual sections see: 33689–33692.

33689 (ZfK-121, pp 1-133) MULTICHANNEL ANALYZERS. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). (In German and Russian).

Twenty papers are presented on multichannel analyzers for nuclear data processing. Topics discussed include errors, memory devices, circuitry, preamplifiers, and stability. (W.H.K.)

33690 (ZfK-121, pp 134-248) NANOSECOND TECHNIQUES. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). (In German and Russian).

Twelve papers are presented on nanosecond techniques for nuclear data acquisition and processing. Topics discussed include nanosecond pulsed light sources, transistorized circuits, pulse amplifiers, time-to-amplitude converters, coincidence circuits, tunnel diodes, and photomultiplier tubes. (W.H.K.)

33691 (ZfK-121, pp 249-319) AUTOMATIC STABILIZATION IN NUCLEAR ELECTRONICS. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). (In German and Russian).

Ten papers on automatic stabilization in nuclear electronics are presented. Topics discussed include stabilization of ion source in U-120 cyclotron, fission chamber system for automatic reactor control, stabilization problems at the JINR 30-MeV bevatron, fast multichannel servo recording system, and beam stabilization at the mass separator. (W.H.K.)

33692 (ZfK-121, pp 320-425) AUTOMATIC MEASURING PROCESSES. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). (In German and Russian).

Eleven papers on automatic data processing systems for nuclear experiments are presented. Topics discussed include recording systems for multichannel pulse analyzers, equipment for neutron activation analysis, equipment for studying the Moessbauer effect, beta spectrometers, and control and recording systems for single-crystal neutron diffractometers. (W.H.K.)

33693 DEVICE FOR NEUTRALIZING HIGH-ENERGY ION BEAMS. Mukhin, Petr Andreevich; Svischev, Vladimir Sergeevich; Shmyglevskii, Iury Dmtrievich. British Patent 1,116,417. June 6, 1968. Filed Apr. 15, 1966.

A device is described which is used to neutralize ion in high-energy ion beams and as an injector of neutral atoms. (B.G.D.)

33694 COMPUTER-CONTROLLED THREE-STAGE MASS SPECTROMETER (Engineering Materials). (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). (CAPE-1737). 45 drawings.

A computer-controlled, three-stage mass spectrometer for high abundance sensitivity isotopic ratio measurements of heavy elements is described. It consists of two symmetric, 90° sector, magnetic analyzers of 12 in. radius in a zero-dispersion configuration followed by a symmetric, 90° electrostatic analyzer also of 12 in. radius. The source is a thermal ionization type equipped with a differentially pumped vacuum lock of the sliding-shaft type. A secondary emission/scintillation detector is employed. Logic diagrams for interfacing a PDP-5 digital computer with the mass spectrometer are included. The computer controls the magnetic sweep current and the ion accelerating voltage by adjusting the associated power supplies as directed by an operating program. Ion pulse counts accumulated in a scaler are stored in the computer which performs statistical calculations on the data and prints out a finished report. (For details see TID-4100 Suppl. 46). (F.S.)

33695 MODIFIED POUND-WATKINS TYPE NMR SPECTROMETER AT 100 Mc REGION. Horai, Kazumi; Horikawa, Naoaki; Kajikawa, Ryoichi; Makino, Fumiyoshi (Nagoya Univ., Japan). Jap. J. Appl. Phys., 7: 619-20(June 1968).

A simple NMR spectrometer successfully operated in the frequency region from 80 to 110 Mc is described. The main feature of this spectrometer is an application of Pound-Watkins type marginal oscillator to such a high frequency band with a long flexible NMR probe which was proved to be versatile in measuring magnetic field strength in a narrow space. (auth)

33696 SOME EXPERIMENTS ON MASS SPECTROMETER. Magari, Saburo. Tech. Rep. Eng. Res. Inst., Kyoto Univ., No. 137, 23p.(Mar. 1968).

The design and performance of the 60 degree single-focus mass spectrometer at the Engineering Research Institute are described. Topics discussed include ion source, magnet system, ion detector system, recorder system, and vacuum system. (W.H.K.)

33697 TIME-OF-FLIGHT MASS SPECTROMETRY. Price, D. (Univ. of Salford, England). Chem. Brit., 4: 255-9(June 1968).

An account is given of the principles, construction and mode of operation of the nonmagnetic linear pulsed time-of-flight mass spectrometer, together with its applications. (UK)

33698 ELECTRONIC EQUIPMENT FOR NUCLEAR MEASUREMENTS, DESIGNED AND CONSTRUCTED IN THE ELECTRONIC DIVISION OF THE JEN. Sanz, Agustin Tanarro (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid), 11: 451-63(Sept.-Oct. 1967). (In Spanish).

Because of the accelerated development of nuclear energy in Spain, the Electronic Division of the JEN has developed and constructed a series of transistorized prototypes for the measurement and analysis of nuclear radiations. These include portable equipment for the detection and measurement of γ radiation, laboratory monitor for β and γ radiation, radioactivity monitor for surveillance of zones and contaminations, electronic pulse counters for radiation detectors, and a one-channel automatic γ spectrometer. The design and functional characteristics of each of these are described. (J.S.R.)

33699 DEVICE FOR WITHDRAWAL OF ^{85}Kr FOR PREPARATION OF RADIOACTIVE KRYPTONATES. Varga, S.; Toelgyessy, J.; Jesenak, V.; Filip, B. (Slovak Technical Univ., Bratislava). Chem. Zvesti, 22: 300-3(1968). (In Czech).

A device for withdrawing and dosing of radioactive krypton has been designed and the procedure has been elaborated. Radioactive krypton ^{85}Kr is adsorbed over charcoal at the temperature of liquid nitrogen. The dosing device is filled with radioactive krypton at atmospheric pressure by desorption of ^{85}Kr from charcoal by means of a mercury manostat. Krypton is withdrawn through a rubber membrane below the mercury level by suction in a syringe. Before repeating this process, the pressure inside the dosing device should be equilibrated to the atmospheric pressure anew. This device makes it possible to withdraw krypton at atmospheric pressure and to control the amount. The device is used for preparing radioactive kryptonates. (auth)

33700 MONOCHROMATOR FOR BREMSSTRAHLUNG. Fomushkin, E. F.; Novoselov, G. F.; Panin, V. I.; Kopalkin, N. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1611-17(Oct. 1967). (In Russian).

A bremsstrahlung monochromator intended mainly for study of photon scattering is described. The instrument is similar in principle and characteristics to, but different in design from that employed by J. S. O'Connell, P. A. Tipler, and P. Axel (Phys. Rev., 126: 228(1962), and is based on the conversion to bremsstrahlung in a thin target of electrons of known energy and the recording of coincidences between scattered bremsstrahlung photons and energy-degraded electrons of known residual energy. The instrument employs 12- to 16-MeV electrons from a linear accelerator that provides 0.5 μsec 50 mA pulses with a 1-2 MeV energy spread at a repetition rate of 2000 sec^{-1}. Monoenergetic electrons are selected from the beam by 90° deflection in a magnetic field and are brought to the thin bremsstrahlung converter through a 2.5 m long vacuum duct traversing the bunker wall. The energy-degraded electron spectrometer employs inclined plane pole pieces (inclination angle, 16°), provides double focusing, and has an electron acceptance solid angle of about 1% or 4π. There are four plastic scintillator electron detectors, of which one is employed to monitor the background. The bremsstrahlung beam is monitored with a thin-wall ionization chamber between the converter and the scattering target. The photon detector employs a 15 × 10 cm NaI(Tl) crystal scintillator and can be positioned at any distance between 50 and 120 cm from the target and at any angle from 0 to 140° to the beam. The electronic equipment features four channels and a fast-slow coincidence circuit providing a coincidence curve with a width of 32 nanosec. The dead time is about 100 nanosec. During the resting and adjustment of their monochrometer the energy dependence of the photon scattering cross sections of Mg and ^{12}C were recorded at energies in the vicinities of 10 and 15 MeV, respectively. Energy resolutions of 150, 220, and 270 keV were achieved in the three monochromator channels, and some 50% of the recorded coincidences were accidental when the electron detector load exceeded 5000 pulse/sec. Gamma cross section peaks corresponding to the 9.5, 9.9, 10.4, and 10.9 MeV levels of ^{24}Mg and the 15.1 MeV level of ^{12}C were recorded. (ATD)

33701 PRELIMINARY PROCESSING OF AMPLITUDE SPECTRA USING MINSK-2 COMPUTER AND OSCILLOGRAPH WITH A LIGHT PENCIL. **Zabiyakin, G. I.; Trubnikov, V. R.; Tsupko-Sitnikov, V. M.; Zvol'ski, I.; Prikhod'ko, V. N.; Tomik, I.; Fominykh, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1600-2(Oct. 1967). (In Russian).**

A system is described which will reduce the time required to process radiation spectra characterizing radioactive atoms by an order of magnitude. In doing so, the disparity between the short measurement time required to obtain a vast amount of information, from several thousands of amplitude analyzer channels and the time required to process that information is diminished. Initially, the complete spectrum is displayed on an oscillograph in the form of a series of points representing the contents of corresponding channels. Cursory qualitative spectrum examination is made at this time and points of interest noted. Portions of the spectrum may be earmarked for enlarged display by means of a light pencil (containing a photomultiplier tube), which is aligned with spectral points of interest. The enlarged display starts with the first point and extends in length to a point entered by the operator at the console. Spectral points which deviate from the general curve are simultaneously corrected by two methods of averaging neighboring points. Raw as well as processed data may be printed or entered on perforated tape. Also, the operator may cause the channel number and number of counts corresponding to this channel to be printed. The points selected with the light pencil, usually peaks, initiate a program which computes the peak area accounting for the presence of noise and delivers the results on the printer. The processed points subsequently become brighter. Further automation of the process is proposed where complex spectra portions with unresolvable peaks would be filmed and expanded into series components. (ATD)

Radiation Effects on Instruments and Instrument Components

Refer also to abstracts 33666, 34768, 34769, and 34782.

33702 CAPACITANCE AND PARALLEL CONDUCTANCE OF MIS STRUCTURES IRRADIATED WITH LOW-ENERGY ELECTRONS. **Castagne, Rene (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 937-9(Apr. 1, 1968). (In French).**

Some results from the measurement of capacitance and equivalent parallel conductance made on structure of Si, SiO, and Al irradiated with electrons at 35, 50, and 100 keV are reported. (tr-auth)

33703 NOISE OF TRANSISTORS AT VERY LOW FREQUENCIES. **Baldinger, E.; Nuesch, E. (Univ., Basel). Helv. Phys. Acta, 41: 313-22(May 15, 1968). (In German).**

Flicker noise measurements were made on two silicon planar transistor pairs in the very low frequency domain from 0.05 to 0.0001 Hz. Even at these low frequencies the noise power density obeys a $f^{-\varkappa}$ law with $\varkappa = 0.65$ respectively 0.86. No systematic deviation from this law was found. Radiating the transistors with ^{60}Co-γ does not invalidate the $f^{-\varkappa}$ law, but may change the exponent $\varkappa$. (auth)

33704 EFFECT OF NEUTRON IRRADIATION ON THIN FILM RESISTORS. **Ramsay, M. M. (Standard Telecommunication Labs., Harlow, Eng.). Thin Solid Films, 1: 405-16(May 1968).**

Thin film resistors representing most of the current manufacturing techniques have been irradiated in a nuclear reactor. After a total dose of 10^{16} fast neutrons cm^{-2} and over 10^{8} RADs of gamma radiation the nichrome resistors, regardless of details of manufacture, all showed a fall in resistance, the median value being 0.035%. After a similar irradiation tantalum resistors, on the other hand, showed an increase of under 0.02%. The temperature coefficient of resistance of tantalum resistors remained constant during irradiation, whereas that of the nichrome resistors showed a considerable increase. These differences in behavior are consistent with the assumption that the tantalum films are continuous or have closely spaced grains and nichrome films are agglomerated. The model proposed by Hill for conduction in agglomerated gold films offers an attractive explanation for the changes observed in nichrome resistors. (auth)

33705 COMPARISON OF SURFACE AND BULK EFFECTS OF NUCLEAR REACTOR RADIATION ON PLANAR DEVICES. **Fitzgerald, Desmond J.; Snow, Edward H. (Fairchild Semiconductor, Palo Alto, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Electron Devices, ED-15: 160-3(Mar. 1968).**

The devices which were irradiated were those known to be sensitive to radiation-induced surface effects: metal-oxide semiconductor (MOS) capacitors, gate-controlled p-n junction diodes, MOS transistors, and bipolar transistors. They were irradiated at room temperature with fast neutron (E > 0.1 MeV) doses of 1×10^{14}, 3×10^{14}, and 1×10^{15} nvt. Bias voltages were not applied during irradiation. Reactor irradiation of planar devices results in permanent bulk effects (lifetime decrease and carrier removal) and permanent surface effects (surface recombination velocity increase and positive charge buildup within the oxide). Surface effects of irradiation were separated from bulk effects, and their relative importance compared. It was shown that the rates of change of surface recombination velocity and lifetime with dose are such that at high doses surface effects have an insignificant influence on p-n junction recombination-generation currents compared to bulk effects. In particular, the degradation of current gain at low collector currents in reactor-irradiated bipolar transistors was shown to be the result of increased recombination in the bulk rather than at the surface of the emitter-base depletion region, in contrast with the case of ionizing radiation alone. (BBB)

33706 RADIATION-INDUCED SPACE-CHARGE BUILDUP IN MOS STRUCTURES. **Mitchell, J. Peter (Bell Telephone Labs., Inc., Whippany, N. J.). IEEE (Inst. Elec. Electron. Eng.) Trans. Electron Devices, ED-14: 764-74(Nov. 1967).**

Analysis of a simple model for radioinduced space-charge buildup in the SiO_2 layer of MOS structures was carried out. The model assumes that hole-electron pairs are created in the SiO_2 by irradiation and that some of the electrons thus created drift out of the SiO_2 layer under the action of an applied potential across the oxide, V_G, while the corresponding holes became trapped. The diffusion of electrons is assumed to be negligible. The analysis predicts: (1) a dependence of charge buildup on radiation dose D, of the form $(1-e^{-\delta D})$; (2) a linear dependence of the charge buildup on V_G, for both polarities of V_G; and (3) the dependence of the charge buildup on the total dose absorbed and not on the rate at which the dose was received. Experimental observations on the SiO_2 layers found in commercial MOS-FET's show good general agreement with the predictions. To obtain quantitative agreement, however, it was necessary to assume that the mobility-lifetime product for electrons in the oxide is much lower at the SiO_2–Si interface than at the SiO_2-metal interface. Other discrepancies were explained as the result of oversimplifications employed in the analysis. In particular, it was necessary to postulate that under some circumstances diffusion of electrons out of the oxide was important and that, in addition to holes, a small number of electrons may be trapped in the oxide in some cases. The space charge was found to accumulate within ≤200 Å of the cathode-oxide interface. (BBB)

33707 THE PHYSICS OF FAILURE OF MIS DEVICES UNDER RADIATION. **Holmes-Siedle, A. G.; Zaininger, Karl H. (RCA Labs., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.) Trans. Rel., R-17: 34-44(Mar. 1968).**

Problems encountered as a result of ionizing radiations effects in semiconductor devices used in satellites and the nature of the changes are reviewed. Planar passivation of Si surfaces removed many major failure problems in the junction device, however, replacing them with more subtle, if less severe, failure problems. An example of these new problems which is considered is the strong effect of ionizing radiation on MOS (metal-oxide-semiconductor) and oxide-passivated junction devices. Unlike the solar cell and the NPN transistor, the MOS device does not sustain a degradation as the principal effect of exposure to radiation. Instead, the MOS device undergoes a change of operating region, the change being in the nature of a parallel shift of the characteristic curve of the device, produced by the trapping of radiation-excited holes within the 2000 Å insulator and the consequent buildup of a fixed bulk space charge in the insulator. Less significant changes under radiation are variations in the shape of the characteristic curve and increased leakage current. These are genuine degradation effects and are closely analogous to the strong effects of ionizing radiation in planar-passivated junction devices such as bipolar transistors, SCRs, diodes, etc. In the latter cases, the devices are acting as MIS (metal-insulator-semiconductor) devices and hole trapping in the oxide is again responsible for their degradation. A consideration of the case of simple MIS devices under radiation is thus found helpful in elucidating some other important types of failure under radiation of Si junction devices. (BBB)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 33586, 33680, 33778, 33786, 33793, 33801–33805, 33807, 33808, 33815, 33823, 33839, 33848, 33851, 33860, 33894, 33895, 33901, 33912, 33924, 33927, 33928, 33977, 33978, 33999, and 35726.

33708 (AD-662723) RADIATION DAMAGE IN MUSCLE MEMBRANES AND REGULATION OF CELL METABOLISM. Final Progress Report No. 3, February 1962–April 1967. Portela, Adolfo (Buenos Aires Univ. (Argentina). Facultad de Ciencias Medicas). Sept. 1967. 14p. CFSTI.

The effects of x radiation upon properties and function of muscle cells were studied. The research program was additionally extended to the study of cell membrane behavior under the presence of cesium and quaternary ammonium ions, as well as to chemical damage studies with enzyme upon the molecular membrane structure. Unfortunately it was not possible to accomplish the proposed idea of studying the effects of x radiation on the membrane mechanisms related to the Ach, Ch interaction, as well as the comparison of the radiation changes and the enzymatic alteration on the muscle membrane. The comparison between mechanical, electrochemical, biochemical and structural changes in frog muscles following x irradiation has contributed fundamentally to a basic understanding of the effects of irradiation on membrane system and control mechanism. Basically, the contribution was again oriented to obtain a better understanding of the effects of ionizing radiation in the sequence of processes taking place in the membrane and responsible for regulating the membrane potential as well as the membrane organization and function. Changes in the membrane permeability and processes of membrane potential regulation, as well as in the processes related to uncoupling of oxidation and phosphorilation due to radiation, were considered an important observation of cell damage. (TAB)

33709 (COO-1603-2) THE EFFECTS OF TRITIUM DECAY ON DNA. Progress Report, January 1, 1967–December 31, 1967. Rachmeler, Martin (Northwestern Univ., Evanston, Ill.). Feb. 5, 1968. Contract AT(11-1)-1603. 9p. Dep. CFSTI.

NUCLEIC ACIDS, DEOXYRIBO-, — radioinduced degradation of, from Escherichia coli, density gradient studies in vitro and in vivo of tritium β
MUTATIONS — radioinduced, in Escherichia coli K12 SH-28, tritium β
ENZYMES — radiation effects on formation of, in Escherichia coli K12 SH-28, tritium β
THYMINE — radioinduced release of, from DNA following degradation, tritium β (H.G.D.)

33710 (JPRS-41315, pp 4-15) EFFECT OF ULTRAVIOLET RADIATION ON MACROMOLECULES, VIRUSES AND CELLS. Vladimirov, Yu. A. Translated from pp 5-14 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966.

A review is presented of the significance of photochemical processes in protein systems. The kinetics of enzyme inactivation resulting from ultraviolet radiation are discussed with emphasis on the nature of photochemical reactions in this process. Studies on the effects of ultraviolet irradiation on photoluminescence of aromatic amino acids and proteins are reviewed. (H.L.W.)

33711 (NYO-3658-9) MICROBIOLOGICAL ASSAYS OF SEAWATER USING RADIOISOTOPES. Progress Report, June 1, 1967–May 31, 1968. Gold, Kenneth (New York Aquarium, Brooklyn. Osborn Labs. of Marine Sciences). Mar. 1, 1968. Contract AT(30-1)-3658. 27p. Dep. CFSTI.

Methods of in vitro cultivation of Tintinnopsis sp. are described. The isolate was maintained in a defined sea water substitute containing Navicula sp., Isochrysis galbana, Rhodomonas lens, and bacterial flora. Carbon-14-labeled amino acids were used for measuring responses to different foods and growth conditions. The growth rate of tintinnids was studied with the aid of autoradiography. Thiamine stability was affected by temperature, pH, concentration of dissolved organic matter, and concentration of trace metal ions. (H.L.W.)

33712 (NYO-2744-53) THE INHERITANCE AND CHARACTERISTICS OF DIFFERENTIAL ELEMENT ACCUMULATION BY MAIZE WITH PARTICULAR EMPHASIS ON STRONTIUM AND CALCIUM. Annual Progress Report. Thomas, W. I. (Pennsylvania State Univ., University Park). May 1968. Contract AT(30-1)-2744. 11p. Dep. CFSTI.

ANGIOSPERMIDAE — Zea mays, selection of high and low strontium accumulating populations of, effects of calcium on; Zea mays, selection of high and low accumulating crosses of calcium, magnesium, phosphorus, potassium, and zinc. (H.L.W.)

33713 (NYO-3728-2) BONE AND BONE MARROW KINETICS. Technical Progress Report, June 1, 1967–March 1, 1968. Gong, Joseph K. (State Univ. of New York, Albany. Research Foundation). Mar. 19, 1968. Contract AT(30-1)-3728. 13p. Dep. CFSTI.

RATS — strontium-85 uptake by, relation of, to osseous activity dental extraction wounds
X RADIATION — effects on bones and bone marrow components of monkeys, mechanisms of recovery from; effects on marrow plasma volume; effects on strontium-85 uptake by bones of rats, effects of ageing on; effects on hematopoiesis in rats, methods for determining (H.L.W.)

33714 (ORO-2687-16) CHLOROPHYLL CONTENT AND RATE OF LIGHT-INDUCED REACTIONS IN NICOTIANA TABACUM. [Progress Report]. Gaffron, Hans (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). May 15, 1968. Contract AT(40-1)-2687. 12p. Dep. CFSTI.

ANGIOSPERMIDAE — Nicotiana tabacum, rate of photosynthesis in chlorophyll deficient mutants and normal plants; Nicotiana tabacum, content of pigments in chlorophyll deficient strains of
CHLOROPLASTS — fine structure of tobacco, relation of, to photosynthetic activity
PHOTOSYNTHESIS — determination of quantum requirements for, in algae and tobacco; fixation of carbon dioxide molecules during, effects of single flash of light on
LIGHT — effects on quantum efficiency in photosynthesis in tobacco comparison of blue and red (H.L.W.)

33715 (SZS-15/67) INHALATION VON RADIOAKTIVEN SUBSTANZEN. LITERATURUEBERSICHT. TEIL I. (Inhalation of Radioactive Substances. Literature Survey. Part I). Gensicke, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Nov. 1967. 50p. (In German). Dep.

A literature survey is presented on some of the essential parameters influencing the deposition, retention, translocation, and excretion of inhaled radioactive substances. In addition to the occurence and the particle size distribution of radioactive aerosols in the atmosphere and in working areas, physical, chemical, and especially physiological factors that influence uptake are discussed. (211 references) (auth)

33716 (UCB-34-P-136-2) RADIATION STUDIES ON MEMBRANE TRANSPORT PROCESSES AND ASSOCIATED ENZYMES. [Progress Report], May 1, 1967–March 31, 1968. Macey, Robert I. (California Univ., Berkeley. Dept. of Physiology). Mar. 25, 1968. Contract AT(11-1)-34. 16p. Dep. CFSTI.

ATPase — estimation of molecular weight of, in membranes of erythrocytes, microsomes, mitochondria, and nerve cells using electrons
ALKALINE PHOSPHATASE — estimation of molecular weight of, in membranes of erythrocytes, microsomes, mitochondria, and nerve cells using electrons
ACETYLCHOLINESTERASE — estimation of molecular weight of, in membranes of erythrocytes, microsomes, mitochondria, and nerve cells using electrons
ERYTHROCYTES — radiolysis of, effects of glucose and thiourea on electron
MEMBRANES — radiation effects on transport processes of, electron (H.L.W.)

33717 (UCLA-12-640, pp 81-90) BIOCHEMISTRY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

FATTY ACIDS — enzymatic activation of long-chain, in subcellular liver preparations from rats
CELLS — isolation of glial, from bovine and murine nervous system tissues
WAXES — synthesis in lantern fish
FATTY ACIDS — radiolysis of saturated, hydrocarbon yields from γ
8-PENTADECYNOIC ACID — synthesis of
9-PENTADECYNOIC ACID — synthesis of (C.H.)

33718 (UCLA-12-640, pp 61-80) RADIOBIOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

PYRIMIDINES — radiolysis of aqueous solutions of, in presence of chloride ions, γ

CELLS—organelles of, function of microvesicular body
NUCLEIC ACID, DEOXYRIBO—synthesis by transferred nuclear nodes from Stentor polymorphus in cytoplasm of Stentor coeruleus
PEROXIDASE—apoisoenzymes and isoenzymes of horseradish, activity, amino acid composition, and structure of
GLYCEROLPHOSPHATE DEHYDROGENASE—synthesis in developing brain of rats; radiation effects on synthesis of, in brain of rats, x (C.H.)

33719 (UCLA-12-640) SEMIANNUAL PROGRESS REPORT [ON NUCLEAR MEDICINE AND RADIATION BIOLOGY] FOR THE PERIOD ENDING, JUNE 30, 1967. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Contract AT(04-1)-Gen-12. 90p. Dep. CFSTI.

Separate abstracts were prepared on five sections of this report dealing with research in nuclear medicine, biophysics, environmental radiation, radiobiology, and biochemistry. (C.H.)

For abstracts of individual sections see: 33586, 33717, 33718, 33778, and 33839.

33720 TRANSFER AMYLOIDOSIS: IN VITRO IRRADIATION OF THE TRANSFERRED SPLEEN CELLS. **Ranloev, Poul (Univ., Copenhagen). Acta Pathol. Microbiol. Scand., 71: 316-17(1967).**

Whether x irradiation of spleen cell suspension from hyperimmunized donors would influence the subsequent amyloidosis in the recipients was examined. Mice of the C3H strain were given 17 daily casein injections and then spleen cell suspension from pooled donor spleens. The spleen cell suspension was divided into two parts; one half was x irradiated at a dose rate of 42.3 RAD/min to a total dose of 1000 RAD. Irradiated and nonirradiated cells were injected intravenously into the syngeneic recipients. Half the recipients were given nitrogen mustard. All recipient mice were killed five days after transfer. It appeared that spleen cells derived from the same pool of presensitized donor spleens proved equally effective in inducing amyloidosis in syngeneic recipients regardless of previous x irradiation of the transferred cells. The results indicated that proliferation within the host of the injected, syngeneic, casein-sensitized donor cells was not necessary for their amyloidosis-promoting effect. Indirectly, these results supported the concept of an interaction between a messenger function related to material derived from the donor cells and reticular cells of host origin. Such a concept agreed with the results in other experiments demonstrating a similar transfer of amyloid disease with subcellular fractions of spleen cells from casein-sensitized donor mice. These findings suggested existence of two different cell types operating specifically for each of the two phases in experimental amyloid formation. (BBB)

33721 THE INFLUENCE OF IONIZING RADIATION ON THE ENZYMATIC ACTIVITY OF MYCOBACTERIUM BOVIS. **Hampl, Jaroslav; Prochazka, Zdenek; Kazda, Jindrich (Vyzkumny Ustav Veterinarniho Lekarstvi, Brno-Medlanky, Czech.). Ved. Pr. Vyzk. Ustavu Vet. Lek. Brne, 4: 69-76(1965). (In Czech.).**

The effects of ionizing irradiation and lyophilization on enzyme activity were compared. Irradiation was carried out with ^{60}Co at a dose rate of 3.1×10^5 R/hr and the dehydrogenase activity in strain B XXXI of Mycobacterium bovis was determined. It was found that the effects of doses of 1×10^5, 2×10^5, and 6×10^5 R resembled the physical effects of the lyophilization process in that the dehydrogenase activity was not significantly affected. The dehydrogenase activity in subcultures cultivated from Mycobacteria that were irradiated at doses of 1×10^5 and 2×10^5 R increased significantly, whereas in a subculture of cells that were irradiated at a dose of 6×10^5 R, dehydrogenase activity was absent. Related effects on enzymes in other strains of Mycobacteria, studied previously, are discussed. (BBB)

33722 ISOLATION OF GRISEOFULVIN FROM PENICILLIUM JANCZEWSKII GROWN IN A DEUTERATED ENVIRONMENT. **Nona, Daniel Aloysius. Urbana, Ill., Univ. of Illinois at the Medical Center, 1967. 166p.**
Thesis.

The deuterium isotope effects upon the growth patterns and nutritional requirements of the griseofulvin-producing mold Penicillium janczewskii, were studied. At high concentrations of deuterium oxide (99.6%), using shake culture techniques, the pellicle size was reduced substantially, and the time required to reach maximum size was approximately doubled. In surface culture, at D_2O concentrations of 99.6%, the organism was able to grow. However, a study of mycelial dry weights showed a reduction of about one-half in comparison to H_2O controls. The fermentation period necessary to attain the maximum weight was doubled. Titers of griseofulvin in fermentor broth of varying deuterium composition were determined by ultraviolet spectrophotometry. Antibiotic concentrations produced by shake cultures were found to be unsatisfactory. Surface cultures were found to be better suited for this investigation. Griseofulvin titers were reduced with increasing concentrations of D_2O, and were severely impaired in pure deuterium oxide. Supplementation of the culture medium with vitamins, however, stimulated antibiotic production. This observation indicates that the deuterium effect may, at least in part, be due to an increased fastidiousness of the deuteriated organism. It appears that a primary effect of deuterium in the fungus is suppression of metabolic activities not essential to life. High deuterium levels result in use of available metabolites to maintain the basic nutrition of the isotopically altered fungus at the expense of antibiotic production. Griseofulvin extracted from the mycelium and culture filtrates was purified by preparative thin layer chromatography, and characterized by its physical properties. The extent of isotopic replacement with deuterium was determined by NMR spectroscopy. Fully deuteriated griseofulvin was obtained using a fully deuteriated medium both by direct fermentation and replacement culture techniques. When the replacement medium was only partially deuteriated an antibiotic was isolated which was deuteriated in part. The in vitro antifungal activity of fully deuteriated, partially deuteriated, and protio-griseofulvin were compared. The antibiotics were evaluated by plate assay with Microsporum gypseum as the test organism. A statistically significant difference was observed in zones of inhibition between fully deuteriated griseofulvin and partially deuteriated and protio-griseofulvin. The deuterio-analog was found to be about 1.28 times as potent as ordinary griseofulvin. No significant difference could be attributed to a comparison of biological activity of partially deuteriated and ordinary hydrogen griseofulvin. The enhanced antifungal activity demonstrated by fully deuteriated griseofulvin may be due to an increased efficiency of action. The antifungal target site may involve the metabolism of a C–D bond directly or indirectly. Since C–D bonds are generally more stable than C–H bonds, the increased stability of the molecule may alter the rate of griseofulvin metabolism by the fungus. (Disser. Abstr.)

33723 METABOLIC STUDIES WITH SELENIATED COMPOUNDS. I. KINETIC STUDIES WITH METABOLISM OF ^{75}SeO$_3$ IN RATS. **Imbach, A.; Sternberg, J. (Univ. of Montreal). Int. J. Appl. Radiat. Isotop., 18: 545-56(Aug. 1967).**

Trace amounts of ^{75}SeO$_3$Na$_2$ were injected intravenously into adult female rats and the blood dynamics, excretion pattern, body burden, and distribution in the subcellular fractions of the liver were examined between 15 min and 72 hr after injection. In blood, selenite is very rapidly bound to the plasma proteins, which act as carriers of the trace element as well as final products of the metabolic incorporation of the isotope. The albumin-bound ^{75}Se prevails in the carrier phase, while during the elaboration phase the isotope is chiefly bound to the α- and γ-globulins. The binding in the carrier phase seems to be of the anionic selenite-basic endings of the serum protein type and can be reproduced in vitro, although to a lesser extent than in vivo. A significant amount of ^{75}Se is exhaled through the lungs during the first 30 min after injection; this is related to the transmethylation of selenite and the formation of the volatile compound Se(CH$_3$)$_2$. This process takes place chiefly within the liver microsomes, and could be taken as an index of the liver function, since experimental modification of the liver capacity results in a modification of the rate of lung excretion of the dimethyl selenide. The kidney is the most important excretion route for selenite; there is little fecal excretion, and only during the first 24 hr after injection. The biliary excretion of selenite is also less important than the urinary elimination; the isotope does not seem to be bound to the common biliary salts. There is little resecretion of selenite through the digestive tube. In the subcellular fractions of the liver selenite is equally distributed among nuclei, mitochondria and microsomes; the largest fraction remains in the soluble liver compounds and is rapidly excreted through the kidney; the soluble ^{75}Se in the liver is not bound to the proteins. (auth) (UK)

33724 MODIFICATION OF THE PROCESS OF BLOOD COAGULATION IN PATIENTS IRRADIATED WITH ^{60}Co γ RAYS. **Paleani Vetorri, G.; Monosi, A.; Trinci, M. (Univ., Rome). Nunt. Radiol., 32: 983-94(Oct. 1966). (In Italian).**

Uncertainty and frequent discrepancies occur in the literature data concerning the influence of ionizing radiations on the coagulation processes, that are explained in part by the different experimental and technical irradiation conditions used each time by the investigators. In order to make the results as comparable as possible to each other, 18 patients were selected who had submitted to radiotherapy with γ rays of ^{60}Co. One group of these patients consisted of carriers of lung newgrowths and a second group of subjects affected by bladder neoplasms; the patients belonging to each group were submitted to radiation therapy carried out with techniques of irradiation very similar to each other. For each patient, complete hemochromocytometric examination, a count of the platelets, a determination of the prothrombin time and a thromboelastogram were performed before and two weeks after the beginning and at the end of the treatment. The results point out the different behavior of the K phase of the thromboelastogram in the two groups of irradiated subjects perhaps in relation to the release of thromboplastin of the lung. (auth)

33725 THE BEHAVIOR OF SOME ERYTHROCYTARY ENZYMES AND METABOLITES IN PATIENTS WITH MALIGNANT NEOPLASMS AFTER TREATMENT WITH HIGH ENERGY (^{60}Co) RADIATION. Fontana, L.; Papa, G.; de Laurenzi, A.; Spina, C.; Giannandrea, G. (Univ., Rome). Nunt. Radiol., 32: 1161-75(Oct. 1966). (In Italian).

The behavior of some erythrocytary enzymes and metabolites were studied in patients affected by malignant newgrowths, before and after radiation therapy with high energies (^{60}Co). They observed that the erythrocytary metabolism after telecobalt therapy did not undergo any important changes in comparison with the initial values; only the ATPase, and the N-acetylneuraminic acid showed some changes, that were however not significant from the statistical point of view. (auth)

33726 CONCERNING THE HEREDITARY TRANSMISSION OF RADIATION CHANGES IN SOMATIC CELLS. Yagunov, A. S. (Central Research Roentgeno-Radiological Inst., Leningrad). Vop. Onkol., 14: No. 2, 43-4(1968). (In Russian).

The ultraviolet fluorescence of Ehrlich ascitic carcinoma cells was investigated. It was demonstrated that following the roentgen irradiation (500 RAD), the intensity of fluorescence of ascitic cells was increased. This high level could be maintained and inherited by subsequent cell generations without showing any tendency toward normalization. (auth)

33727 DNA SYNTHESIS IN STRAINS OF E. COLI K12 HFR C AND ITS SLIME-PRODUCING MUTANT FOLLOWING ULTRAVIOLET IRRADIATION. Likhoded, L. Ya.; Saenko, A. S. (Inst. of Epidemiology and Microbiology, Moscow. Inst. of Medical Radiology, Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol., No. 3, 95-8(Mar. 1968). (In Russian).

Synthesis of DNA by ultraviolet irradiated strains of Escherichia coli H12 Hfr C and its radiosensitive mutant (lon-mutant) were investigated. Doses producing different lethality of E. coli K12 Hfr C and its lon-mutant were used. The data revealed that DNA synthesis of these strains was restored at the same time and proceeded at the same rate. (auth)

33728 INFLUENCE OF WHOLE-BODY X-IRRADIATION ON THE URIDINE DIPHOSPHATE GLUCOSE SYSTEM OF GLYCOGEN SYNTHESIS IN BONE MARROW CELLS. Filippova, V. N.; Soldatenkova, L. I. (Inst. of Hematology and Blood Transfusion, Leningrad). Radiobiologiya, 6: 804-6(1966). (In Russian).

The disturbance of the enzymatic pathways of glycogen synthesis in the bone marrow of animals subjected to ionizing radiation were studied. Whole bone marrow of rats and isolated bone marrow cells of rabbits were examined 24 hours after whole-body x irradiation at a dose of 1000 R. In the experiments on whole bone marrow of rats, it was found that incorporation of the glycosyl coenzyme UDPG-^{14}C into glycogen was sharply reduced after irradiation; however, the interpretation of this result was complicated by an intensified decomposition of glycogen under these conditions. Small and statistically insignificant changes in the UDPG-glycogen synthetase and phosphoglucomutase activities were observed in experiments on isolated rabbit bone marrow cells. However, irradiation sharply reduced the UDPG-pyrophosphorylase activity of the rabbit bone marrow cells. (JPRS)

33729 SUBSTRATE PROTECTION OF LACTIC ACID DEHYDROGENASE AGAINST INACTIVATION BY IONIZING RADIATION. Yost, Henry T. Jr.; Goetzl, Edward J. (Amherst Coll., Mass.). Radiat. Res., 33: 293-302(1968).

Lactate acid dehydrogenase was irradiated in the presence of its substrates and the coenzymes. The coenzymes afforded protection against the inactivation by irradiation over the entire pH range studied. Both pyruvate and lactate afforded specific protection to the enzyme at the pH optima for their binding. Studies of the four isozymes present in the LDH preparation indicated that the irradiation caused no major structural changes. However, there was an indication of slight configurational changes. These data support the concept of specific substrate protection. Furthermore, the data support the hypothesis that the substrate can bind to LDH independently of the coenzyme and that this binding is strongly pH-dependent. (auth)

33730 IODINE INCORPORATED IN CELL CONSTITUENTS DURING SENSITIZATION TO RADIATION BY IODOACETIC ACID. Shenoy, M. A.; Singh, B. B.; Gopal-Ayengar, A. R. (Bhabha Atomic Research Centre, Bombay). Science, 160: 999(May 31, 1968).

Iodine atoms are incorporated in bacterial membrane proteins when cells are irradiated in the presence of iodoacetic acid labeled with iodine-131. Such atoms are produced on reaction of iodoacetic acid with the gamma ray-induced hydroxyl radicals in the surrounding medium. (auth)

33731 IN VIVO EFFECTS OF X RAYS ON THE LIFE SPAN OF RABBIT ERYTHROCYTES. Dantchev-Urbain, Monique; Dantchev, Dimitre (Laboratoire de Recherches de l'Academie Nationale de Medecine, Paris). Compt. Rend., Ser. D, 264: 2022-4(April 17, 1967). (In French).

Red blood cells of rabbits were labeled in vivo with ^{51}Cr. Twelve days later the animals were given 100 to 600 R of x radiation. A graph is presented to show the decrease in radioactivity of normal blood cells, irradiated cells, and cells treated with phenylhydrazine. The activity of the irradiated cells disappears by the 54th day, while that of the normal cells and cells treated with phenylhydrazine does not disappear until the 60th day. Results show that radiation reduces the life span of the erythrocytes and that the young cells are especially sensitive to radiation. (H.L.W.)

33732 FLUORESCENCE EXCITATION OF CHLOROPHYLL IN GREEN PLANTS BY β PARTICLES. Pearlstein, Robert M. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Biochim. Biophys. Acta, 153: 504-7(Feb. 12, 1968). (ORNL-P-3421).

The use of β particles to excite the fluorescence of chlorophyll in vitro was investigated; the ultimate aim was to observe the subnanosecond decay profile of impulsively excited fluorescence. A schematic diagram of the experiment is presented. It was found that green leaves luminesced under excitation by β particles. The luminescence yield was at least 0.4 photon per incident β particle from the ^{147}Pm source. The integral luminescence spectrum excited by the β particles closely resembled the integral chlorophyll fluorescence spectrum excited by blue light. The luminescence yield of 0.4 together with reasonable assumptions implied that the passage of one β particle through a leaf excited some 160 molecules of chlorophyll a. (B.S.L.)

33733 BEHAVIOUR OF MITOCHONDRIAL FATTY ACIDS IN RAT LIVER FOLLOWING TOTAL BODY LETHAL AND SUBLETHAL IRRADIATION. Notario, A.; Slaverio, G. P. E.; Pallavicini, E. Bobbio (Univ., Pavia, Italy). Panminerva Med., 10: 31-5(Jan.-Feb. 1968).

Changes in albino rat liver mitochondrial fatty acid percentages following whole-body single lethal dose and repeated sublethal dose x-irradiation were studied. Gas chromatography of methyl esters of mitochondrial fatty acids showed that such irradiation caused shifts in C_{16}-C_{18}-C_{20} saturated/unsaturated acid ratios. There was an overall depression of desaturation due to clear decreases in monosaturated acid values that were not offset by comparatively modest increases in corresponding polysaturated acids. (auth)

33734 CURRENT STATUS OF CHEMICAL STUDIES ON THE ORIGIN OF LIFE. Ponnamperuma, Cyril; Gabel, Norman W. (Ames Research Center, Moffett Field, Calif.). Space Life Sci., 1: 64-96(Mar. 1968).

The paths by which life appeared on earth in relation to: the time scale; nature of the primitive atmosphere; energies available for synthesis of organic compounds, i.e., uv radiation, electric discharge, ionizing radiations, and heat; precellular organization; and the synthesis of biologically important molecules, i.e., amino acids, purines and pyrimidines, monosaccharides, nucleosides and nucleotides, hydrocarbons and fatty acids, porphyrins, polypeptides, and polynucleotides are reviewed. (169 references) (B.S.L.)

33735 EFFECT OF X-RAYS ON ARYLESTERASE ACTIVITY OF THE BLOOD AND ORGANS IN RATS. Savitskii, I. A.; Levitskii, A. P. (Pirogov Odessa Medical Inst., Odessa). Ukr. Biokhim. Zhr., 40: 76-8(1968). (In Ukrainian).

The activity of arylesterase (substrate: phenylacetate) in homogenates of the liver, pancreas and duodenum as well as in the serum of albino rats at various times (1 hour, 1, 3, and 10 days) after whole-body irradiation at a 600 R dose was determined. A drop was established in arylesterase activity in the organs and a rise of activity was noted in the serum at all periods of investigation. The maximal inhibition of arylesterase activity in the organs (one hour for the liver and three days for the pancreas and duodenum) coincided with the maximal rise of activity of the serum. On the basis of data obtained it was assumed that the source of blood arylesterase was not only the liver but also the other organs. (auth)

33736 CHANGES IN THE ACTIVITY OF SOME AMINOTRANSFERASES IN RABBITS IN COMBINED ACTION OF X-RAYS AND EMBITOL. Savitskii, I. V.; Tsybul'skii, V. V. (Odessa Medical Inst.). Vop. Med. Khim., 13: 364-9(July-Aug. 1967). (In Russian).

Total x irradiation of rabbits (960 R) led to changes in the activity of alanine aminotransferase and aspartate aminotransferase. Shifts in the activity of the latter are characterized by a preponderant fall of the enzyme activity in a majority of the investigated organs, except the liver. This fall was the most pronounced in 7 days. Embitol (12.4 mg/kg, administered once) also caused shifts in the aminotransferase enzymatic reactions, with a preponderant rise of the enzyme activity during all the observation periods, except the first 24 hours. This rise was observed in a majority of the organs investigated and was the most pronounced on the 15th and 7th days after the administration of the preparation. Combined action of embitol and irradiation promoted a rise of the aminotransferase enzyme activity in cases in which it was considerably reduced as a result of radiation. (auth)

33737 NUCLEOTIDE COMPOSITION OF DNA FRACTIONS OF BONE MARROW IN NORMAL AND X-IRRADIATED ANIMALS. Kritskii, G. A.; Arends, I. A.; Nikolaev, Yu. V. (Inst. of Biochemistry, Moscow). Biochemistry (USSR) (Engl. Transl.), 32: 372-6(May-June 1967).

Translated from Biokhimiya, 32: 452-7(May-June 1967).

A difference in the base ratios between low and high polymer DNA fractions of rabbit bone marrow was revealed. The size of the ratio A/C of high polymer fraction I was approximately 18% larger than the low polymer fraction II. The composition of nitrogenous bases of DNA was different from the normal immediately after the influence of ionizing radiation in vivo at doses of 2000 and 200 R. Immediately after exposing the organism to ionizing radiation the ratio of nitrogenous bases in DNA fraction II did not comply with the Chargaff rule: the size of ratios A/T and G/C exceed unity. The most significant changes right after irradiation were in the size of ratio A/C that decreased in the high polymer DNA fraction and increased in the low molecular DNA fraction (with a dose of 2000 R, on the average about 40%). The ratio G/G in the low polymer DNA fraction increased an average of 32% in doses of 2000 R and 16% with doses of 200 R. According to the majority of indexes, changes in base ratio in high polymer fractions were much less significant and carried inverse character on the average with changes in the low polymer DNA fraction. (auth)

33738 STUDY OF γ-IRRADIATED RIBONUCLEASE BY THE METHOD OF GEL FILTRATION. Maksimov, V. I.; Osipov, V. I.; Kaverzneva, E. D. (Inst. of Organic Chemistry, Moscow). Biochemistry (USSR) (Engl. Transl.), 32: 334-8(Mar.-Apr. 1967)

Translated from Biokhimiya, 32: 403-8(Mar.-Apr. 1967).

The structure of RNAase after γ-irradiation of the enzyme in the dry form in an atmosphere of nitrogen was investigated by gel filtration through Sephadex G-100. It was found that the tertiary structure of RNAase was changed in practically all the molecules as a result of irradiation. In contrast to native RNAase, the irradiated preparation manifested conformational instability that depended upon the conditions. Treatment of irradiated RNAase with cysteamine in alkaline medium did not lead to a restoration of the native structure. The enzyme activity was lowered even more in this case, and the conformational instability of the protein was preserved. The hyperchromic effect that arose in the irradiated RNAase disappeared after treatment of the protein with cysteamine. (auth)

33739 THE EFFECT OF IONIZING RADIATION ON THE BIOSYNTHESIS OF CERTAIN FRACTIONS IN THE KIDNEY SOLUBLE PROTEIN. Sukhomlinov, B. F.; Datskiv, M. Z. (Order of Lenin Iv. Franko State Univ., Lvov). Ukr. Biokhim. Zh., 39: 654-8 (1967). (In Ukrainian).

By electrophoresis on agar gel conjugated with the electrophoregram autoradiography the effect of x radiation on the biosynthesis of soluble kidney proteins of rabbits was studied. The disturbance of biosynthesis in these proteins was measured by methionine-^{35}S incorporation. The methionine was administrated to the animals 19 hours before slaughter. It was established that the kidney soluble proteins of intact animals separated into 12 fractions in the electric field. The radiation effect on rabbit organism was distinguished in the correlation between the disturbance in some fractions of soluble kidney proteins. The nature of changes in the intensity of methionine-^{35}S incorporation in the fractions of soluble kidney proteins at ionizing radiation effect in various periods of radiation illness testified to the irregularity of the protein metabolism in the rabbit and also characterized the extent of radiation lesion and development of pathological process. (auth)

33740 URANIUM DISTRIBUTION IN THE BODY OF RATS IN INHALATION OF AMMONIUM DIURANATE. Galibin, G. P. Gig. Sanit., No. 12, 40-3(Dec. 1967). (In Russian).

Tests performed on rats showed that in inhalation of ammonium diuranate 14% of the inhaled amount of the substance was retained in the body. On slow introduction of the fraction (~5%) the time of its elimination from the lungs amounted to 240 days. The time of its elimination from the skeleton equaled 300 days, that from the kidneys, liver and spleen did not exceed 20 to 30 days. (auth)

33741 RADIOSYNTHESIS AND METABOLISM OF METHYLTHIO ARYL PHOSPHOROTHIONATES IN CALVES AND BLOOD SUCKING ARTHROPODS. Young III, Seth Yarbrough. Auburn, Ala., Auburn Univ., 1967. 115p.

Thesis.

A technique was developed for the radiosynthesis of sulfur^{35}-labeled p-hydroxyaryl methyl thioethers that can be used as intermediates in the synthesis of several organophosphorus insecticides. This technique was then used to synthesize ^{35}S–Bayer 9017 {O,O-diethyl O[^{35}S-4-(methylthio)-3,5-xylyl] phosphorothioate}. The Bayer 9017 was purified on a Florisil column with gas chromatography being used to monitor the elution of the ^{35}S–Bayer 9017 and side reaction products from the column. The metabolism and associated residues of ^{35}S–Bayer 9017 were studied in dairy calves using radiotracer techniques. Two calves were treated, one orally at the rage of 50 mg/kg with a solution containing 52 per cent of Bayer 9017 and the second calf treated dermally, at the rate of 310 mg/kg with a solution of two per cent Bayer 9017. The calves were held for 24 hours after treatment during which time blood samples were taken at four-hour intervals with urine and feces collected quantitatively. ^{35}S–Bayer 9017 and its metabolites were isolated and identified by selective solvent extraction and thin-layer co-chromatography. Bayer 9017 was quickly degraded in the calves to hydrolytic products and rapidly eliminated in the urine primarily as water soluble conjugates of the phenols. The peak concentrations of radioactivity in the urine of both calves were reached at six hours after treatment. Little elimination of ^{35}S-materials occurred in the feces and most that was excreted consisted of organo-soluble materials. Bayer 9017 and all five of its oxidation products were found in both the urine and feces. Levels of radioactivity in the blood in both calves were highest at 12 hours after treatment with the level in the calf treated dermally being somewhat higher than in the calf treated orally. Residues of Bayer 9017 present in most tissues were much higher in the calf treated dermally; residues in the muscle tissue were six times higher than in the calf treated orally. Much of the radioactivity in the tissues were present as hydrolytic products, primarily as water soluble conjugates with little free phenols being present in most tissues. Activation of Bayer 9017 occurred in both the thiophosphoryl and thioether groups with all five possible oxidation products being present. In the third phase of this investigation, the absorption and metabolism of ^{35}S–fenthion in two species of blood sucking arthropods, the stable fly, Stomoxys calcitrans (L.), and bed bug, Cimex lectularis L. were studied. Eight groups of each species were treated topically with one μl of a 0.4 ppm solution of fenthion in acetone. Two replicates of each species were sacrificed at 0, 1, 4, and 24 hours after treatment. It was observed that nearly 90 per cent of the ^{35}S–fenthion was absorbed by the stable fly. Activation in this insect was rapid with 35 per cent of the absorbed dose being present as oxidation products after one hour. All five possible oxidation products were present. However, after 24 hours much of the absorbed dose was degraded and one-half of this dose was excreted as water soluble conjugated phenols. Absorption of fenthion by the bed bug was not as rapid as in the stable fly. Only 50 per cent of the application was absorbed after 24 hours. Degradation and excretion were also slower in the bed bug and only 18 per cent of the absorbed dose was excreted after 24 hours. The oxidation products formed in the bed bug were similar to those found in the stable fly. (auth) (Disser. Abstr.)

33742 REACTION OF ULTRASTRUCTURE OF BLOOD CAPILLARIES TO TOTAL BODY IRRADIATION. Voitkevich, A. A.; Dedov, I. I. (Inst. of Medical Radiology, Obninsk, USSR). Arkh. Patol., 30: No. 3, 13-22(1968). (In Russian).

Changes in the capillary ultrastructure of the supraoptic nucleus in rats, irradiated to a dose of 900 R were studied. The nerve tissue exhibited signs of edema 24 to 72 hours after irradiation. Endothelial cell nuclei became hypertrophic, and pinocytosis was intensified. During the culminative phase of radiation sickness, the following destructive changes occurred in the vascular wall; mitochondrial cristae became fragments, the matrix of the latter was subjected to lysis, and the number of pinocytotic vesciels and microvilli was reduced. Leukocytes and erythrocytes migrated from the capillary through the vascular wall. In such areas capillary endothelial lining became deformed, and the basal membrane became laminated. Individual endothelial cells, enlarging, demonstrate the capacity for division by mitosis or amitosis. (auth)

33743 IN VITRO AND IN VIVO EFFECTS OF γ-RADIATION ON COMMON-FLY BRAIN CHOLINESTERASE. Catalan, R. E.;

Municio, A. M. (Inst. of Chemistry, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 63: 1145-56(Dec. 1967).

Preparations of cholinesterase of different grades of purity, from a number of sources were exposed to ^{60}Co γ radiation at a dose rate of 2.5×10^5 R/hr. Cholinesterase activity was measured at periods of 1 to 24 hr after irradiation. Results showed that radioinduced inactivation of the enzyme preparations differed greatly according to the grade of purity of the samples, length of storage time following irradiation, and temperature during storage. Cholinesterase activity in samples irradiated in the dry state exhibited a direct effect while samples irradiated in solution exhibited an indirect effect of irradiation that was independent of the grade of purity of the preparation. Studies on cholinesterase from irradiated intact brains of the common house fly showed a radioprotective effect for the cholinesterase inhibitors tested. These included 3,ethyl-4-methylsulfonylphenyl-o,o′-diethylphosphate and N,N-dimethylcarbamate. (C.H.)

33744 EFFECTS OF INHALED YTTRIUM OXIDE ON BLOOD LACTIC ACID, ERYTHROCYTE VOLUME, AND HISTOLOGIC FEATURES OF LUNGS IN EXERCISED DOGS. Reece, William O.; Talbot, Richard B.; Swenson, Melvin J. (Iowa State Univ., Ames). Contract AT(11-1)-1170. Amer. J. Vet. Res., 28: 979-92(July 1967).

Eighteen Beagle dogs, 6 to 9 months of age, were subjected to treadmill exercise and exposure to a chamber atmosphere of yttrium oxide. The exposure lasted 30 days (180 exposure hours), and treadmill exercise was given for 10 minutes a day throughout the experiment. Postexercise value of blood lactate concentration was determined twice a week, and erythrocyte volume, plasma volume, hemoglobin concentration, and leukocyte count were determined before the start, and at the end, of the exposure period. Analysis was based upon a paired experiment. A significant increase was seen in blood lactic acid concentration and total leukocyte counts. A slightly significant decrease was seen in erythrocyte volume. A significant difference was not seen in plasma volume and hemoglobin concentration. In dogs having a marked increase in post-exercise blood lactate concentration, erythrocyte volume was decreased. Hypertrophy, hyperplasia, desquamation of the alveolar epithelial cells, and leukocyte infiltration were seen in the lungs. Connective tissue was not increased. It appears that concentration of blood lactic acid after treadmill exercise might be used to evaluate substances where the toxicity becomes apparent when greater functional activity is demanded of certain systems of the body. (auth)

33745 CESIUM UPTAKE BY SUDANGRASS SEEDLINGS FROM FOUR SOILS IN SOUTHERN CALIFORNIA. Kaddah, Malek T. (Univ. of California, Riverside). Contract AT(11-1)-34 P. 92. Soil Sci., 105: 369-75(May 1968).

The uptake of Cs added to four soils in micro- and macro-amounts in the presence of various salts was studied by a modified Neubauer technique using sudan grass as the testing plant. The amounts of Cs added per 100 g soil varied from 10^{-7} to 1 meq CsCl. Analysis of the shoots of 10 days old seedlings for Cs showed that little differences were exhibited among the four soils when the Cs additions ranged from 10^{-7} to 10^{-2} meq/100 g soil. With increasing Cs addition wide variations occurred among the soils with less Cs taken up from the vermiculitic soils than from the non-vermiculitic soils. Cesium uptake in the second cutting of any treatment was generally greater than Cs uptake in the first cutting. Cesium toxicity symptoms commenced when the Cs concentration in the shoots was 0.02 to 0.03 meq Cs/g dry shoots. The toxicity symptoms started as blanched, water-soaked areas and as reddish-brown streaks which spread with ultimate drying of the shoots. When Cs was added to soils in microamounts ($\leq 10^{-4}$ meq/100 g) with different salts, the availability of Cs was influenced by the salt concentration especially by K and NH_4 salts and by the sequence of addition of Cs and K or NH_4 salts. In general, increasing concentration of K ions decreased Cs uptake, whereas NH_4 ions increased Cs uptake in some soils and had little or depressing effect on Cs uptake in other soils. When 0.1 meq CsCl was added to 100 g soils, the enhancing effect of NH_4 ions on Cs absorption did not occur. Increasing concentrations of K or NH_4 ions decreased Cs uptake. The results indicate also that Cs ions under this macro-concentration affected the availability of both K and NH_4 ions. For any concentration of added Cs, the uptake of Cs was higher when it was added after rather than before NH_4 or K ions, especially in vermiculitic soils and with increasing Cs concentration. (auth)

33746 UV INDUCED CONFORMATIONAL CHANGES IN TRANSFER RNA. Sarin, P. S.; Johns, H. E. (Univ. of Toronto). Photochem. Photobiol., 7: 203-10(Feb. 1968).

The quantum yields for the uv inactivation of the amino acid acceptor function of E. coli transfer RNA and for the loss of its conformation, as a function of exposure, were determined following irradiation at 280, 265, and 254 nm. Results suggest that uv damage produces a change in the conformation of transfer RNA that in turn inactivates it, and that the anticodon is not the uv-sensitive site. Calculations indicate that a small number of photoproducts inactivate the transfer RNA. (auth)

33747 RECOMBINATION OF UNPAIRED ELECTRONS IN IRRADIATED PROTEINS AND POLYPEPTIDES. L'vov, K. M. (Inst. of Biological Physics, Moscow). Biophysics (USSR) (Engl. Transl.), 12: 398-401(1967).

Translated from Biofizika, 12: 347-9(1967).

The recombination of unpaired electrons in γ- and uv-irradiated proteins and synthetic polypeptides was measured. The type of radiation had no effect on recombination. The mechanism of recombination of unpaired electrons in proteins is discussed. (C.H.)

33748 CONJUGATE OXIDIZING PHOSPHORYLATION IN COTTON SEEDLINGS IN NORMAL STATE AND IRRADIATED BY GAMMA-RAYS. Arslanova, S. V. (Inst. of Experimental Biology of Plants, Tashkent). Uzb. Biol. Zh., No. 1, 9-12(1968). (In Russian).

After γ-irradiation of cotton seeds, it is found that oxygen consumption increased in cell mitochondria of cotton roots, binding of inorganic phosphorus decreased, and correlation P/O was reduced. The disturbance of regulation mechanism of oxidizing processes combined with phosphorylation results in accumulation of pyroracemic acid in leaves and stems of cotton. (auth)

33749 EFFECT OF FERTILIZERS AND PRE-SOWING IRRADIATION OF SEEDS BY GAMMA-RAYS OF ^{60}Co ON THE QUALITY OF MAIZE CORN. Vlasyuk, P. A.; Mar'ina, V. V. (Ukrainian Academy of Agriculture, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, No. 2, 167-71(1968). (In Ukrainian).

Irradiation of seeds of the maize hybrid Kievtky 8 by γ rays at a dose of 1000 R grown with full mineral fertilizer contributed to the increase of protein content in a corn by 0.67%. For the maize hybrid Bukovinsky 3 a positive effect on protein content was not observed. Under the effect of manganese superphosphate the protein content increased by 0.68 – 0.98% in both maize hybrids. A direct relationship was noted between the content of protein and zein in the maize corn and action of irradiation and fertilizers. For hybrid Bukovinsky 3 the irradiation causes some decrease of the content of zein in corn. (auth)

33750 MODIFICATIONS INDUCED BY IONISING RADIATIONS ON THE ANTIGENIC CELL STRUCTURE OF ASCITE EHRLICH TUMOUR. Piccotti, F.; Farinet, G.; Cirillo, R. (Univ., Turin). Med. Nucl. Radiobiol. Lat., Suppl. 1, 562-6(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063–(Suppl.1)(Vol.1).

Antigenic modifications induced by radiotherapy on Ehrlich ascites tumor were studied by evaluating the immune efficiency of irradiated cells after incubation of different times and temperatures. Results showed that incubation of irradiated cells caused progressive loss of antigenic power as a function of temperature. (auth)

33751 ROLE-OF MITOCHONDRIA IN THE DEPOSITION OF $^{90}Sr^{++}$ IN THE ANIMAL TISSUES. Carafoli, E. (Univ., Modena, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 134-9 (1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063–(Suppl.1)(Vol.1).

After injection of ^{89}Sr into rats, the distribution of radioactivity among liver subcellular fractions showed a typical pattern: the largest part of the radioactivity was associated with the mitochondria, while minor quantities were recovered in the other subcellular organelles. The uncoupling of oxidative phosphorylation in vivo with pentachlorophenol decreased very markedly the amount of ^{89}Sr associated with the mitochondria. The results demonstrated that energy-linked movements of Sr^{++} take place in the mitochondria of the living liver cells. It is suggested that mitochondria play an important role in the deposition of Sr^{++} in animal tissues. (auth)

33752 ROLE OF PROTEIN SYNTHESIS IN THE REPAIR OF IONISING RADIATION DAMAGE. Castellani, A.; Magaudda, G.; Trezza, G. (Centro Studi Nucleari della Casaccia, Rome). Med. Nucl. Radiobiol. Lat., Suppl. 1, 140-55(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063–(Suppl.1)(Vol.1).

Repair phenomena in x-irradiated Escherichia coli B were studied. Holding the irradiated cells in buffer for various times before plating led to an increase in survival (liquid holding recovery) that is, the potentially lethal damage caused by irradiation was repaired. Cell survival increased in relation to the time of holding in buffer. The dose reduction factor and the reactivable sector were measured from the survival curves at a fixed time

(4 hours) of holding in buffer. The increase in radiation dose had a detrimental effect on this type of repair up to 4,000 R when no increase in survival was observed. A resumption of the liquid holding recovery phenomena was observed if the cells, immediately after irradiation (10,000 R), were kept in complete synthetic medium at 37°C with aeration for the period of time corresponding to the division delay caused by irradiation (60 minutes). Measurements of the incorporation of ^{3}H leucine in the trichloroacetic acid insoluble fraction of the irradiated cells showed that, during the treatment in complete synthetic medium, protein synthesis was active in spite of the fact that no duplication of the irradiated cells took place. The resumption of the liquid holding recovery after a treatment that allows protein synthesis, presumably involved a reactivation of the repair systems. (auth)

33753 EXPERIMENTAL CONTRIBUTIONS TO THE STUDY OF IRRADIATION EFFECTS OF RNAase IN VITRO. Calzavara, F.; Pozza, F. (Univ., Padua). Med. Nucl. Radiobiol. Lat., Suppl. 1, 177-85(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

During a study of macromolecular damage by x radiation, water solutions of RNAase (RNAase A) were irradiated with energy x radiation at a dose that produced inactivation by 50%. The effect of the dose absorbed on the structure and composition of the enzyme molecule was qualitatively and quantitatively determined. Results are described. (auth)

33754 PATHOGENIC CONSIDERATIONS OF LYSOSOMIAL MODIFICATIONS OF IONIZING RADIATIONS (FIRST EXPERIMENTAL RESEARCH). Meneghini, C.; Farisano, G.; Pulido, E. (Univ., Padua). Med. Nucl. Radiobiol. Lat., Suppl. 1, 173-6(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

HeLa cells smears were irradiated at 300, 1000, 3000 and 5000 R. Only after irradiation with 3000 R did the first significant structural and distributive modifications occur (histochemical detection) in the lysosomes. Lysosome damage was more apparent after irradiation with 5000 R; the lysosomes appeared to increase in number and volume and were irregularly distributed in the entire cytoplasm. Other enzymohystochemical studies were successively conducted to clarify the possible pathogenic mechanism of the damage. It was thus observed that irradiation at 3000 and 5000 R elicited severe and significant unbalance of the cellular metabolism with modifications in oxidative proteolytic and glycolytic processes. Structural and distributive lysosomes modifications were therefore considered successive and consequential to other metabolic and structural lesions of the cytoplasm. (auth)

33755 β-GLUCURONIDASE ACTIVITY IN IRRADIATED RATS. Scoppa, P. (EURATOM, Ispra, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 255-63(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Supol.1) (Vol.1).

After whole-body x-irradiation (600 R), the β-glucuronidase activity in rat urine increased up to four times normal level during the first 48 hours. An increase in urine production as well as in reduction of food intake that was caused by irradiation accounted for this increase. Increases in unit enzymatic activity in homogenates of liver, kidney, and small intestine resulted from weight loss by these organs; no corresponding loss of enzymatic protein was observed and total activity per organ was not significantly altered. Comparison with paired-fasted animals showed that the results could be explained by reduced food intake following irradiation. β-glucuronidase activity in the serum of irradiated rats did not vary. Results are discussed in relation to studies on urinary elimination of glucuronide and UDPglucuronyltransferase activity. (auth)

33756 EXPERIMENTAL TRIALS IN THE QUANTITATIVE ESTIMATION OF EXPOSURE TO SMALL IONISING RADIATION DOSES THROUGH MICROSCOPE OBSERVATION OF STRUCTURAL ALTERATIONS IN CELL NUCLEI. Martinenghi, C.; Fidanza, M. A. (Univ., Milan). Med. Nucl. Radiobiol. Lat., Suppl. 1, 264-78(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Panirradiation-induced structural alterations of thymocyte nuclei in young rats (1 to 2 months) and of circulating lymphocytes of adult animals were studied. After irradiation some cellular nuclei lost their characteristic structure and appeared homogenized; the frequency of homogenized nuclei varied according to the dose administered. Variations were observed in frequency of structural alterations of thymocyte nuclei relating not only to the dose but also to the length of time between panirradiation and death of the animal. The time of incubation of blood samples that were taken immediately after panirradiation was also found to influence lymphocytes alterations. Exposure doses gave statistically significant variations in frequency of nuclear alterations. Apart from supplying information on the strength of physical exposure doses, the test constituted an interesting index of hematological damage that varied according to different exposure conditions and to individual radiosensitivity. (auth)

33757 BEHAVIOUR OF A STABLE CELL LINE CULTURED IN A MEDIUM CONTAMINATED BY ^{137}Cs. I. ^{137}Cs UPTAKE. Rossi-Torelli, M.; Polese, E.; Avio, C. M. (Univ., Pisa, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 281-8(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Liver cells of mouse embryo were cultured in a medium contaminated with ^{137}Cs. Development of cells and Cs uptake were studied. During the first four days cell growth was equal to that in noncontaminated cultures. Unit uptake ratio, i.e., the amount of radioactivity in a single cell in relation to the radioactivity in the medium, decreased during the first four days while the number of cells increased. During this period, no changes in cell morphology was seen. The amount of ^{137}Cs in the medium (0.018 to 2.4 μCi/ml) did not affect the size of the growth after four days. The uptake of ^{137}Cs by a single cell was related to the concentration of ^{137}Cs in the medium. Under the stated experimental conditions, the Cs uptake was a direct function of the Cs concentration in the medium. Saturation or inhibition of cell growth by Cs invalidated this function. (auth)

33758 BEHAVIOUR OF A STABLE CELL LINE CULTURED IN A MEDIUM CONTAMINATED BY ^{137}Cs. II. MORPHOLOGICAL ASPECTS. Polese, E.; Rossi-Torelli, M.; Avio, C. M. (Univ., Pisa, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 289-95(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

No morphological changes were seen in liver cells that were cultured for four days in a medium with 2.4 μCi/ml of ^{137}Cs added. The same cells, cultured in a medium with 1 μCi/ml of ^{137}Cs for as long as 30 days, showed some morphological and reproductive modifications. Morphological changes were as follows: Giant cells with little cytoplasm, one large nucleus or many smaller nuclei; both cytoplasm and nuclei stained dark; chromatin is scattered in large flakes. Polynucleated cells with a very thin ring of cytoplasm; nuclei varied in shape, size and stained normal; chromatin was often condensed in one border granule. Cellular reproduction changes were atypical mitoses, chromosome breaks, and amitotic divisions. (auth)

33759 PHARMACO-METABOLIC INDUCTION FROM X-RADIATIONS. Chiesara, E.; Botturi, M.; Conti, F.; Fanti, A.; Poggi-Longostrevi, M. (Univ., Milan). Med. Nucl. Radibiol. Lat., Suppl. 1, 344-51(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The behavior of the pharmaco-metabolic enzymes of the liver of irradiated rats was examined. A physical stimulus of 650 R on the hepatic area alone or on the whole body increased enzymatic activity in the liver (microsomic level); this occurred in 23-day-old rats while there was no response in adult rats whose hepatic cells were at biological equilibrium. In confirmation of this, liver cells in hepatectomized adult rats reacquired the potential capacity of young cells and this renewed their sensitivity to the physical stimulus of irradiation. (auth) (TSS)

33760 FREE RADICALS AND MOLECULAR DAMAGE FROM X IRRADIATION. Blasi, F.; Fragomele, F. (Univ., Naples). Med. Nucl. Radiobiol. Lat., Suppl. 1, 125-33(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Irradiation of substances in the solid state causes the formation of long-lived free radicals whose study with electron spin resonance (ESR) spectroscopy has greatly contributed to understanding the mechanism of action of ionizing radiations at the molecular level. ESR spectra of proteins irradiated in the solid state are originated by the trapping of the irradiated energy in given points of the protein molecule (i.e., -S-S- bridges). The mechanism of this energy migration was studied in keratin and lysozyme. Disulfide bridges were not essential to this process. Energy was trapped in sulfur atoms also in the carboxymethylated lysozyme. The loss of the native structure, however, induced by the treatment with 6 M guanidine, caused total loss of the capacity of the protein to trap the migrated energy. This showed that the native structure of protein was essential in the process of energy migration. (auth)

33761 METHOD OF DETERMINING RADON CONTENT IN THE AIR EXHALED BY MEN. Gusarov, I. I.; Abramov, V. I.; Ivanov, Z. G. (Central Scientific-Research Inst. of Physical

Therapy, Moscow. Central Graduate School of Medicine, Moscow). Gig. Sanit., No. 8, 71-7(Aug. 1967). (In Russian).

Studies were made of technical methods for determining the presence of small concentrations of radon in the air exhaled by people. The design and performance of an installation for radon absorption on coal are included. The device permits extraction of radon from a large volume of air, transfer into an emanation chamber, and determination of radon concentration in air up to 1×10^{-15} Ci/l. In the region in which the content of natural radioactive background with the content of radon in the drinking water was 1×10^{-8} Ci/l, the concentration of radon in exhaled air was from 4 to 34×10^{-15} Ci/l. (R.V.J.)

33762 IDENTIFICATION OF THE WATER RADICALS INVOLVED IN X-RAY INACTIVATION OF ENZYMES IN SOLUTION AND DETERMINATION OF THEIR RATE OF INTERACTION WITH THE ENZYME. Sanner, Tore; Pihl, Alexander (Norwegian Radium Hospital, Oslo). Biochim. Biophys. Acta, 146: 298-301 (Sept. 12, 1967).

Trypsin was inactivated by x radiation as an exponential function of the dose. Protective substances used were acetone, adenine, ethanol, glucose, glycerol, glycylglycine, sodium formate, and thymine. These substances acted primarily by a radical scavenger mechanism. When the relevant rate constants for the OH radical were used, a straight line was obtained. (H.L.W.)

33763 AFTER EFFECTS IN X-IRRADIATED AMINO ACIDS. Hussmann, Eckart (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Strahlentherapie, 135: 489-92(Apr. 1968). (In German).

After the roentgen irradiation of a water solution of aliphatic amino acids after-reactions were observed. The reactions were studied by means of uv spectrophotometry. A method is described that permits the determination of changes of the extinction value during the after-reaction and the extinction spectrum of the end products. Two after-reactions occurred. (auth)

33764 THE EFFECT OF IONISING RADIATION ON STATIONARY CONCENTRATION OF THE METABOLITES OF ANAEROBIC GLYCOLYSIS IN THE LIVER OF RATS WHOLE-BODY IRRAIDATED BY THE DOSE OF 1400 R. Zicha, Blahoslav; Benes, Jiri; Dienstbier, Zdenek (Charles Univ., Prague). Strahlentherapie, 135: 467-78(Apr. 1968). (In German).

The stationary content of glycolytic intermediates in liver of rats exposed to 1400 R was studied. The steady state constants of corresponding glycolytic reactions were calculated and compared with those of apparent thermodynamic equilibrium. A high elevation of glucose, glucose-6-phosphate and fructose-6-phosphate was estimated. A biphasic diminution of ATP level occurred with corresponding enhancement of AMP level. Similarly a biphasic decrease of NAD and NADH appeared but the redox ratio did not change except for 12 hours after irradiation. After irradiation, no order changes occurred of steady state constants either for bifunctional or one way limiting reactions in liver. (auth)

33765 ACTIVITY OF ALDOLASE (ALD) AND LACTATE DEHYDROGENASE (LDH) OBSERVED IN PANIRRADIATED RABBITS. Ragaglini, G.; Fanciulli, S.; Mengaldo, R. (Ospedale Civile, Viareggio, Italy). Radiobiol. Radiater. Fis. Med., 22: 287-305(Sept.-Oct. 1967). (In Italian).

A notable increase in the activity of aldolase and of lactate dehydrogenase was observed in blood serum of rabbits following whole-body exposure to an 800 R dose of x radiation. Measurements were made at intervals from 12 hrs to 30 days after irradiation. This increase was attributed to: the processes of mobilization of the various enzymatic systems of the cells; the lack of utilization by the liver; and a decrease in the activity of aldolase and lactate dehydrogenase at the tissue level of the glucose anerobic cycle. It was concluded that the primary site of radiation injury was the biochemical activity of the cells, which in turn affected metabolism in the entire organism. (C.H.)

33766 MECHANISM OF INTENSIFICATION IN CHOLESTEROL BIOSYNTHESIS AFTER THE IRRADIATION. Tret'yakova, K. A. (Inst. of Experimental Endocrinology and Chemistry of Hormones, Moscow). Vop. Med. Khim., 14: 191-6(Mar.-Apr. 1968). (In Russian).

X irradiation of anesthetized rats at a dose of 800 R leads to the intensification of cholesterol biosynthesis in the liver and adrenal glands. The same results were obtained after irradiation of non-anesthetized animals. The increase in cholesterol biosynthesis was characterized by the latent period and took place 5 hrs after irradiation. The local irradiation of the liver at the same dose failed to change the rate of cholesterol biosynthesis. The intensification in cholesterol biosynthesis probably can be explained by the activation of the system hypophysis-adrenal glands, and by the tissue breakdown. The increased cellular permeability and the activation of enzymes responsible for cholesterol biosynthesis as well may contribute to the phenomenon observed. (auth)

33767 MOLECULAR WEIGHT OF Na, K-ATPASE APPROXIMATED BY THE RADIATION INACTIVATION METHOD. Makao, Makoto; Nagano, Kei; Nakao, Toshiko; Mizuno, Nobuko; Tashima, Yotarao; Fujita, Michiya; Maeda, Hiorshi; Matsudaira, Hiromichi (Tokyo Medical and Dental Univ. National Cancer Research Inst., Tokyo). Biochem. Biophys. Res. Commun., 29: 588-92 (Nov. 30, 1967).

An estimation was made by the radiation inactivation method of the molecular weight of sodium, potassium–ATPase prepared from pig brain microsomes. The calculations were based on the phosphorylation reaction of the enzyme with ATP^{32} and the overall hydrolysis of ATP. (F.M.M.)

33768 CYTOSINE–THYMINE ADDITION PRODUCT FROM DNA IRRADIATED WITH ULTRAVIOLET LIGHT. Wang, S. Y.; Varghese, A. J. (Johns Hopkins Univ., Baltimore). Biochem. Biophys. Res. Commun., 29: 543-9(Nov. 30, 1967). (NYO-2798-33).

The uv irradiation of DNA resulted in the formation of an addition product. The probable structure suggested by spectroscopy was 6-4′-[pyrimidin-2′-one]-thymine. This compound was formed from an intermediate consisting of cytosine and thymine and involved a new type of photoreaction. (F.M.M.)

33769 AUTORADIOGRAPHY BY ELECTRON MICROCOPY. Rechenmann, R. V. (EURATOM, Wageningen, Netherlands). J. Nucl. Biol. Med., 11: 111-31(July-Sept. 1967).

An electron microscopic method of autoradiography is described in detail. Emphasis is placed upon rigorous control of the different techniques involved in this method. Some results of a preliminary critical study are given. A brief description is given of some original apparatus used at certain stages of these techniques. The problem of resolution is tackled mainly from the angle of the range of tritium β-particles in ionographic emulsions. (auth)

33770 RADIATION DAMAGE OF PURINES AND PYRIMIDINES. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 46: No. 1, 1-6(1968).

Purine and pyrimidine bases and their nucleotides with phosphoric acid residues were separated from the aqueous solution of ATP, GTP, CTP and UTP with Dowex-1-formate column. Utilizing this preparation, the above four triphosphate nucleotide solutions were irradiated with 2×10^5 R γ rays and then the degree of irradiation damage was investigated. With respect to the radiosensitivity, it was found that the compounds were resistant to gamma irradiation in the order of adenine, guanine, cytosine and uracil compounds. This may be attributable to the number of hydroxyl groups of the molecule of compounds studied. The fact that purines were more radioresistant than pyrimidines may be attributable to the difference of molecular weight. Further, in purine nucleotides the radioresistance was proportional to the number of their phosphoric acid residues. (auth)

33771 AN EFFECT OF GAMMA IRRADIATION ON SOLUTION OF SOLUBLE AND RIBOSOMAL RNAs. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 46: No. 1, 7-12(1968).

From growing Euglena cells, RNA was extracted by phenol method and separated into s- and r-RNAs with MAK column. Both RNA solutions (RNA solved in 0.1 M phosphate buffered saline, pH 6.7) were irradiated with ^{60}Co gamma rays in doses of 1 × and 2×10^5 R, and then examined spectrophotometrically. Irradiation of these solutions gave a proportional increase in absorption to dose. The irradiated s-RNA showed a slight red shift in λ_{max} with dose. When these irradiated solutions were heated at different temperatures, they changed as follows: the decrease of optical density of s-RNA was inversely proportional with dose at temperatures of 40° to 80°C; λ_{max} of s-RNA showed a slight blue shift with dose; irradiation of r-RNA gave no shift in λ_{max}, but the optical density at 260 mμ increased linearly with dose; absorption of irradiated s-RNA solution increased sigmoidally with increasing amount of heat, while that of the irradiated r-RNA solution increased almost linearly with heat; Tm of both irradiated RNAs was slightly higher than that of the non-irradiated RNAs; and s-RNA was slightly more sensitive to γ irradiation than r-RNA. (auth)

33772 GENETICALLY REINFORCED RADIATION EFFECT WHICH IS REPRODUCED ON TRANSPLANTATION OF IRRADIATED CELLS OF LYMPHSARCOMA. Kondrat'eva, T. M.; Pinto, R. I. (Central Research Inst. of Radiology, Moscow. Inst. of Cytology, Moscow). Dokl. Akad. Nauk SSSR, 177: 948-50(Dec. 1, 1967). (In Russian).

In irradiated cells of the peripheral blood and bone marrow an increase in the intensity of uv-fluorescence is noted. This effect was investigated by giving an x-ray dose of 500 R to rats with a developed ascites tumor. Living cells were placed in a Tyrode solution (pH 7.2) containing acridine orange (AO), and the intensity of the uv-fluorescence was measured on a special rig. The uv-fluorescence (UVF) increased 2 to 4 hours after irradiation, and stabilized at a new level one to two days later. Ascites cells from irradiated rats were transplanted to non-irradiated animals, and these cells showed a high level of uv-fluorescence over a period of many generations. This increased uv-fluorescence is considered to be a sensitive indicator of radiation damage to the cell. (TTT)

33773 ACTIVITY OF CATALASE AND CYTOCHROME OXIDASE IN PLANTS HAVING DIFFERENT RADIOSENSITIVITIES. Babaeva, M. K.; Seisebaev, A. T. (Inst. of Biological Physics, Moscow. Inst. of Experimental Biology, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR, 178: 1198-1201(Feb. 11, 1968). (In Russian).

Bean seeds were selected as the radiosensitive plant, and were given ^{137}Cs gamma doses of 0.1 and 10 kr. Clover seeds were picked as the radioresistant plant, and were given gamma doses of 10 and 200 kr. The irradiated and control seeds were steeped in water at 22°C for 24 hours. The catalase and cytochrome oxidase activities were determined in the roots of the plants on the 3rd, 7th and 12th days, and in the leaves of the plants on the 12th day after steeping. The catalase activity was determined gasometrically, and the cytochrome oxidase activity was determined by a spectrophotometric method from the change in optical density of reduced cytochrome C at 550 mμ. In the radiosensitive plant (the bean) the catalase activity did not decrease at first, but did decrease on the 12th day, particularly at a dose of 10 kr. No change in catalase activity could be observed on irradiating the radioresistant clover seed at doses of 10 and 200 kr. A temporary increase in cytochrome oxidase activity was noted only on administration of lethal doses (10 kr for the bean and 200 kr for the clover). (TTT)

33774 EFFECTS OF IONIZING RADIATION ON ACTIVITY AND LOCALIZATION OF ACID PHOSPHATASE IN RAT TESTES. Bublitz, G.; Merker, H. J.; Guenther, Th. (Strahlenabteilung des Staedt. Auguste-Viktoria-Krankenhauses, Berlin. Freie Univ., Berlin). Fortschr. Geb. Roentgenstr. Nuklearmed., 108: 238-45(Feb. 1968). (In German).

The behavior and localization of acid phosphatase in the testes of rats was studied after ionizing radiation (^{60}Co). In unirradiated rat testes, lead phosphate deposits occur in the lysosomes of the Sertoli cells and in the Golgi apparatus of the spermatocytes, with an activity of acid phosphatase of 0.5 (μMol/PO$_4$/mg Prot.). After irradiation with 4,000 R, there is diffuse distribution of the acid phosphatase in the Sertoli cells. Forty-eight hours after irradiation no acid phosphatase can be demonstrated in the Golgi apparatus of the spermatocytes. After irradiation with 1,000 R, there is slower decline in acid phosphatase activity in the spermatocytes than after 4,000 R. In the Sertoli cells one finds damaged as well as intact lysosomes. No changes can be observed after 500 R. Biochemically determined activity of acid phosphatase reaches a maximum at forty-eight hours after 1,000 R with a value of 1.0 (μMol/PO$_4$mg Prot.) and falls to its initial value after seventy-two hours. The significance of the lysosome system in the development of cell damage due to ionizing radiation is discussed. (auth)

33775 THE INFLUENCE OF INITIAL SALT STATUS ON ABSORPTION OF RUBIDIUM BY CORN ROOT SEGMENTS OF TWO STAGES OF DEVELOPMENT. Venrick, Dana M.; Smith, Richard C. (Univ. of Florida, Gainesville). Bull. Torrey Bot. Club, 94: 501-10(Nov.-Dec. 1967).

Apical and basal root segments (consisting primarily of meristematic and elongated cells, respectively) of four-day corn seedlings were tested for various characteristics of active transport, both with and without a preliminary exposure to KCl for 24 hr. The tissue was permitted to absorb ^{86}Rb from a 0.1 m$\underline{M}$ RbCl solution. Rubidium-86 ions held by adsorption or present in the apparent free space were removed prior to radioassay. The results showed that both apical and basal segments displayed the following characteristics of active transport: absorption resulted in high ^{86}Rb accumulation ratios; the absorbed ^{86}Rb ions were retained by the tissue in the presence of external KCl solution; K$^+$ in the experimental solution inhibited uptake whereas Na$^+$ did not; lowering the temperature reduced the rate of ^{86}Rb uptake to such an extent that Q_{10} values were greater than 2.0. Pretreatment of the seedlings for 24 hr with 1.0 m$\underline{M}$ KCl resulted in a subsequent reduction in rate of ^{86}Rb absorption by apical segments but had little effect on absorption of ^{86}Rb by basal segments. In both kinds of segments, pretreatment with KCl was followed by the same characteristics of active transport of ^{86}Rb described above. These data indicated the active transport of Rb$^+$ into both apical and basal corn root segments, and they also showed that a long exposure to KCl did not prevent subsequent active transport of Rb$^+$. (BBB)

Ecology

33776 (COO-1336-6) REACTION OF NATIVE ANIMALS LIVING IN THE VICINITY OF AN UNDERGROUND NUCLEAR DETONATION. Final Report. Jorgensen, Clive D. (Brigham Young Univ., Provo, Utah). Mar. 1, 1968. Contract AT(11-1)-1336. 115p. Dep. CFSTI.

NUCLEAR EXPLOSIONS, UNDERGROUND—effects on immediate and long-term movements of small mammals at Nevada Test Site

INSECTA—Eleodes sp., radiation effects on, at Nevada Test Site following underground nuclear explosion; Eusattus dubius, radiation effects on, at Nevada Test Site following underground nuclear explosion; Edrotes sp., radiation effects on, at Nevada Test Site following underground nuclear explosion; Trogloderus costatus, radiation effects on, at Nevada Test Site following underground nuclear explosion; Pelecyphorus sp., radiation effects on, at Nevada Test Site following underground nuclear explosion; Stenopelmatus fuscus, radiation effects on, at Nevada Test Site following underground nuclear explosion

ARACHNIDA—Globipes spinulatus, radiation effects on, at Nevada Test Site following underground nuclear explosion; Anuroctonus phaeodactylus, radiation effects on, at Nevada Test Site following underground nuclear explosion

ARACHNIDA—Vejovis sp., radiation effects on, at Nevada Test Site following underground nuclear explosion (H.L.W.)

33777 (TID-3910(Suppl.5)) TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography. Klement, Alfred W. Jr. (Nevada Operations Office (AEC), Las Vegas. Office of Canal Studies); Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology). Apr. 1968. 77p. Dep. CFSTI.

A list of 862 selected references to recent publications on radioecology of terrestrial and fresh-water organisms is presented. Related bibliographies are listed as a supplement. (C.H.)

33778 (UCLA-12-640, pp 45-60) ENVIRONMENTAL RADIATION. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

ANGIOSPERMIDAE—growth of seedlings of, effects of ecological and physiological factors on; growth of cuttings of, effects of ecological and physiological factors on; radiosensitivity of, effects of ecological conditions on; uptake of rare earths by, effects of soil conditions on

SEED—germination of Russian thistle, effects of moisture and temperature on

GAMMA RADIATION—effects on reproduction of insectivorous lizards, environmental low-dose

FISSION PRODUCTS—dispersion in soils, effects of chelating agents on; dispersion in atmosphere from KIWI-A reactor test at Nevada Test Site

NEVADA TEST SITE—fission product contamination of environment at, from KIWI-A reactor test; ecology of animals and plants at

IODINE-131—metabolism in mice, rabbits, and rats

RADIATION DOSIMETERS, THERMOLUMINESCENT—performance of, attached to free-living rodents (C.H.)

Genetics and Cytogenetics

Refer also to abstracts 33863, 33864, 33881, 33899, 33929, 33935, and 33956.

33779 (AECL-2791) AN INCREASED YIELD OF GAMMA INDUCED EYE COLOUR MUTATIONS FROM CHRONIC VERSUS ACUTE EXPOSURES IN DAHLBOMINUS. Baldwin, W. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov. 1967. 16p. (CONF-671209-2). Dep. CFSTI. CAN $0.50.

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria.

The interpretation of apparent differences in the mutagenic effects of chronic and acute irradiations is often complicated because the exposed cells may not have remained in comparable stages of the mitotic cycle in the two circumstances and because it is usually impossible to test for differential killing following the two treatments. Thus, in the first case, the early part of a chronic exposure could have the effect of slowing down the rate at which cells proceed through the subsequent normal sequence of changes in radiosensitivity. A method of avoiding this source of bias in studies of the eye color mutations of Dahlbominus was sought, and it was found that susceptibility to induced mutation reached a plateau in ageing females at about 9 days after they became adult, and that over the following four days the mutation rate maintained a comparatively constant frequency. Also, accurate records of the number of cocoons parasitized by Dahlbominus, and the number of progeny per female, made it possible to test for differential killing by seeing if decreased fecundity was associated with a depression of mutagenic rates. Studies of the effects of 500 rads of γ delivered chronically over the period of comparable sensitivity, i.e., over 100 hours from 9 days to 13 days after the pupal stage, and of the same dose as acute exposures at different times in this period are not complete, and are complemented by similar studies using 250 rads. The results with 500 rads indicate an approximately 20% greater mutagenic effect of the chronic as compared with the acute exposures. At the present time, an interpretation in terms of a possibly greater lethal effect of the acute irradiations on cells that are potentially more susceptible to mutagenesis cannot be ruled out. However, any contribution from this source should diminish with lower, less lethal doses. The results at 250 rads show that the difference in mutation frequency with acute as compared with chronic doses is less at this lower exposure, implying that the difference in effect is probably the result of a disproportionately greater killing by the acute irradiation of cells which would have produced mutations. Records of parasitization and the number of progeny per female following acute and chronic exposures at 500 and 250 rads give conflicting results, indicating that differential killing may not be a factor in determining mutagenesis. The results are based on 923 eye color mutations in a total of 346,171 flies scored. (auth)

33780 (NYO-3905-2) VIRUS INDUCED MUTATION. Progress Report. Baumiller, Robert C. (Georgetown Univ., Washington, D. C.). May 29, 1968. Contract AT(30-1)-3905. 10p. Dep. CFSTI.

INSECTA—*Drosophila melanogaster*, radioinduced mutations in, effects of sigma virus on x
SPERM—radioinduced recessive lethal mutations in, of Drosophila, effects of sigma virus on x
OOCYTES—radiation effects on, of Drosophila, effects of sigma virus on x
EGGS—radioinduced dominant lethality in, of Drosophila, effects of sigma virus on x (H.L.W.)

33781 PRELIMINARY OBSERVATIONS ON THE CORRELATION BETWEEN CHROMOSOME DUPLICATION AND DNA REPLICATION. Monesi, V.; Crippa, M. (CSN della Casaccia, Rome. Univ., Cagliari, Italy). Monit. Zool. Ital., Suppl., 72: 1p. (Oct. 1964). (In Italian). (RT/BIO(65)14).

Cells of *Hamster cinese* were exposed to x-ray doses of 150 R. They were incubated with thymidine-^{3}H. At various times after the exposure the frequency of aberrations of the chromatidic and chromosomatic types were analyzed. In non-irradiated cells the cellular cycle was 19.8 hr and 7.2 hr for the synthesis of DNA. Irradiation induced a mitotic delay of about 3 hrs. In general the transition between the two types of aberration occurs toward the end of the presynthetic period. (J.S.R.)

33782 ACCUMULATION OF CELLS WITH CHROMOSOME ABERRATIONS IN THE NORMAL AND IRRADIATED MURINE LIVER. Kononenko, A. M.; Polyakh, N. Ya. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Tsitologiya, 9: 1391-8(Nov. 1967). (In Russian).

The probability of appearance of cells with chromosome aberrations was estimated in the cell population of the murine liver. About 10% of the normal liver cells become aberrant within a month. A study on kinetics of cells with chromosome aberrations after x-irradiation of four-month-old mice with a 400 RAD dose showed that the theoretical suppositions coincided with the experimental results if the irradiation led to the formation of block of mitotic activity of liver cells followed by a renewal of normal activity; if there was a 100% mitotic lethality of aberrant cells; and if the subsequent mitotic activity decreased exponentially. (auth)

33783 DEPENDENCE OF CHROMOSOMAL ABERRATIONS ON INTENSITY OF γ RADIATION AND WHEAT PLOIDY. Filev, K.; Gechev, K. (Inst. of Genetics and Plant Breeding, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1089-92(1967).

Air-dried seeds of *Triticum monococcum* L., *T. durum* Desf. and *T. aestivum* L. were irradiated with ^{60}Co γ rays at dose rates of 17 and 264 R/min for total doses of 18 kR. The seeds were steeped in water for 3 hr and then allowed to germinate at 20 to 22°C. Cytological analyses of the primary root tips were made and the volume of the nucleus of each cell and the percentage of cells with chromosome bridges and acentric fragments were determined. With an increase in ploidy, there was an increase in the percentage of bridges and fragments (total yield of chromosome aberrations). The bridges predominated when the dose rate was 17 R/min and the fragments predominated when the intensity was 264 R/min. Also, there was a decrease in the yield of aberrations per chromosome; the percentage of damages per chromosome was highest in the diploid form and lowest in the hexaploid form. It was concluded that the radiosensitivity of wheat forms differing in ploidy differed considerably in character and that there was hardly any justification for referring solely to a direct causal nexus between chromosomes and radiosensitivity. (B.S.L.)

33784 GENETIC EFFECTS OF X RAYS ON LATENT MAIZE SEEDS. INFLUENCE OF TEMPERATURE CHANGES ON SEEDS FOLLOWING IRRADIATION. Van de Walle, C. (Institut de Botanique, Liege). Bull. Soc. Roy. Sci. Liege, 36: 725-38(1967). (In French).

Maize seeds of two different genotypes are used. In the first, the seeds are heterozygous for the yellow-green gene on chromosome 9 (Yg_2/yg_2). In the other, the seeds have an hypoploid embryo in which the short arm of one chromosome 9 is lost; only one dominant yellow-green allele (Yg_2/—) is present. When, by irradiation, the dominant allele is inactivated or lost, the cell concerned and its progeny are unable to develop their normal green color. Seedlings deriving from irradiated seeds show yellow-green or white streaks on their leaves denoting the progeny of mutant cells. These streaks are counted each time on the second leaf. This gives a quantitative estimate of the genetic damage. The seeds are irradiated by x rays (190 kV, 18 mA) and stored for several days before germination. The genetic damage produced by a given dose of x rays is markedly increased when the seeds are stored after irradiation at room temperature. This storage effect is not affected between −10°C and +50°C, but no storage increase is produced as long as the seeds are kept at −80°C. It can, however, appear later when the seeds are stored again at normal temperature. On the contrary, a shock treatment (8 hours at 70°C or ½ hour at 85°C), just after irradiation, prevents the development of the storage effect at normal temperature. Such a shock is ineffective if applied after the storage period. The interpretation of these results is discussed. (auth)

33785 MITOTIC CHROMOSOMES IN NORMAL AND X-RAY IRRADIATED GALLUS DOMESTICUS. Oprescu, S.; Constantinescu, O.; Voiculescu, I. Stud. Cercet. Biol., Ser. Zool., 18: 282-4(1966). (In Rumanian).

Investigations were performed concerning mitotic chromosomes in normal and x-irradiated chickens. The cytogenetic method was used. It was found that chickens exposed to 200 R showed higher mitotic rates than controls, and those exposed to 1600 R revealed an interphasic aspect in most of the investigated cells. Morphologically, the telocentric aspect prevailed in the VII and XII pairs of chromosomes, except the VII and IX submetacentric pairs. (Romanian Sci. Abstr.)

33786 ELECTRONIC ASPECTS OF THE LETHAL AND MUTAGENIC EFFECTS OF UV LIGHT. Dyadyusha, G. G.; Danilov, V. I.; Shramko, O. V. (Inst. of Organic Chemistry, Kiev). Mol. Biol., 1: 539-43(July-Aug. 1967). (In Russian).

The lowest triplet states of pyrimidine bases and some derivatives were studied by SCF open-shell and closed-shell methods. The triplet excitation was nearly completely localized on the 5−6 bond, and therefore photodimerization was favored. A correlation between the extent of triplet localization in the 5−6 bond and ease of dimerization is shown. Investigation of the ground state of cytosine and cytosine hydrate in the neutral and cationic forms showed that the deamination of cytosine proceeds through the ionic form. The relation between the data obtained and the mutagenic effect of uv light is discussed. The 5−6 bond order, unpaired electron density (where applicable), and the electron density for both atoms 5 and 6 for the ground state and the first triplet of the following molecules are tabulated: uracil, 6-methyluracil, thymine, orotic acid, 5-aminouracil, cytosine, 5-methylcytosine, 5-nitrouracil, 2-thiothymine, isocytosine, and 6-azathymine. (BBB)

33787 CHANGE OF THE MUTAGENIC EFFECT OF UV-RADIATION CAUSED BY THE INCORPORATION OF 5-BROMOURACIL INTO THE BACTERIAL DNA. Skavronskaya, A. G.; Pokrovskii, V. N.; Likhoded, L. Ya.; Gol'dina, L. R. (Gamaleya Inst. of Epidemiology and Microbiology, Moscow). Genetika, 4: No. 4, 99-104(Apr. 1968). (In Russian).

It was shown that 5-bromouracil (5BU), being incorporated into the DNA of bacteria, increased their sensitivity not only to the lethal, but also to the mutagenic effect of uv-rays (the induction of prototrophy). The mutagenic effect of uv radiation on bacteria containing 5BU increased at a higher rate than the lethal effect. The increase of the mutagenic effect was due to the presence of 5BU in the bacterial DNA and probably as the result of the loss of capacity of reparation of premutational lesions and the consequent increase of their frequency. The increase in the mutagenic effect of uv rays under the influence of 5BU suggested that the induction of prototrophy is associated with the uv-induced lesions, located, like all the other premutational changes, in the DNA. (auth)

33788 RELATIVE VIABILITY OF HETEROZYGOTES AND HOMOZYGOTES WITH RESPECT TO THE IRRADIATED CHROMOSOME IN DROSOPHILA MELANOGASTER. Shilenko, B. V. (Inst. of General Genetics, Moscow). Genetika, 4: No. 4, 65-77 (Apr. 1968). (In Russian).

It was shown that the change of the average relative viability of genotype on the irradiation of the second normal chromosome was dependent on a homologous chromosome. Upon irradiation the variability of the relative viability of the heterozygotes CyL/+ and Gla/+ and the nonlethal homozygotes +/+ as well as homeostatic reaction of genotype were larger than that without the irradiation. (auth)

33789 INFLUENCE OF THE GENOTYPE ON THE FREQUENCY OF RADIATION-INDUCED ANEUPLOIDY IN THE OOGENESIS OF DROSOPHILA MELANOGASTER. III. CLARET-NONDISJUNCTIONAL. Glotov, N. V. (Inst. of Medical Radiology, Obninsk, USSR). Genetika, 4: No. 4, 60-4(Apr. 1968). (In Russian).

In the progeny of ca^{nd} females (the anomaly of the achromatin spindle) the spontaneous frequency of exceptional XXY-females and that of exceptional XO-males was 3.7 and 11.0 percent respectively. Dose-effect curves were plotted for the frequencies of XXY-females and XO-males resulting from irradiated ca^{nd} female parents (^{60}Co γ rays at doses of 1, 2, 3, 4 and 5 kR). The comparison of these curves (the values for the control being subtracted) to the dose-effect curves for the yellow females with telocentric X-chromosomes, for the X^c, y v females with ring X-chromosomes and for the females y/y sc^{s4} In 49 v sc^8; Cy/+ (with the disturbed pairing, interchromosomal effect) showed good agreement of all curves. On the basis of the data reported the conclusions drawn were as follows: The frequencies of the radioinduced and the spontaneous aneuploidy were realized by different mechanisms. The radioinduced increase of the frequency of aneuploidy was less than the differences between the spontaneous frequencies of aneuploidy in genetically different Drosophila stocks. (auth)

33790 CHANGES OF CHROMOSOME NUMBERS IN EHRLICH ASCITES TUMOUR CELLS INDUCED BY X-RAYS. Efimov, M. L.; Nugmanov, E. U.; Kleinbok, T. S. (Kazakh Research Inst. of Oncology and Radiology, Alma-Ata, USSR). Genetika, 4: No. 4, 141-7(Apr. 1968). (In Russian).

Ehrlich ascites tumors were x irradiated in vivo; in some cases, in vitro irradiation was carried out before intraperitoneal transplantation. The stem line of chromosomes changed from 46 to 44 in the 46th generation when irradiated in vivo and in the 30th generation when irradiated in vitro. The number of cells in the polyploid interval increased. These changes were accompanied by an increase in the radiosensitivity of the tumor. A possible connection between the acquired radioresistance of the tumor and its diploidization is discussed. (auth)

33791 INDUCED ALLOPOLYPLOIDIZATION OF AUTOTETRAPLOID BRASSICA CAMPESTRIS. Srinivasachar, D.; Singh, K. P. (Indian Agricultural Research Inst., New Delhi). Genetica, 38: 375-80(1967).

Seeds of a variety of allogamous Brown Sarson (Brassica campestris) were irradiated with gamma rays either before or after duplication of their chromosome number by colchicine. Tetraploids from seeds irradiated before duplication had mean quadrivalent and chiasma frequencies of 1.85 and 28.35, respectively. Those from seeds irradiated after duplication had frequencies of 2.82 and 29.94, while unirradiated tetraploids had 2.77 and 30.53, respectively. Small structural aberrations inducing preferential pairing are assumed to have caused the lower quadrivalent frequency after the first treatment. The results suggest that it may be more expedient to induce allopolyploidlike chromosome behavior by irradiation at the diploid than at the tetraploid level. (auth)

33792 THE PERSISTENCE THROUGH SEVERAL REPLICATION CYCLES OF MUTATION-PRODUCING PYRIMIDINE DIMERS IN A STRAIN OF ESCHERICHIA COLI DEFICIENT IN EXCISION-REPAIR. Bridges, B. A.; Munson, R. J. (Medical Research Council, Harwell, Eng.). Biochem. Biophys. Res. Commun., 30: 620-4(Mar. 27, 1968).

A dose of uv (10 ergs mm^{-2}) calculated to produce several doz pyrimidine dimers per chromosome did not cause any detectable reduction in growth rate of exponentially growing Escherichia coli WP2 hcr^-. As judged by photoreversibility of mutations to prototrophy, dimers at mutable sites persisted for up to about 3.75 generation times after uv and could give rise to mutations with a low probability in each replication cycle during this period. (auth)

33793 INFLUENCE OF ANOXIA ON RADIATION-INDUCED BREAKS IN THE ESCHERICHIA COLI CHROMOSOME. Achey, Phillip M.; Whitfield, Vivien G. (Univ. of Florida, Gainesville). J. Bacteriol., 95: 1180-1(Mar. 1968).

Escherichia coli, grown in tritium-labeled thymine, was irradiated with 40 kRAD in oxygen or in nitrogen. The molecular weights of the DNAs isolated from these cells were determined from the sedimentation rates in an alkaline sucrose gradient using T2 DNA as a reference. Cells irradiated in oxygen yielded DNA of a lower molecular weight than those either unirradiated or irradiated in nitrogen. The results support the interpretation that oxygen enhances radioinduced breaks in the DNA molecule as it does colony survival and DNA replication. (M.M.B.)

33794 POSSIBILITIES OF THE INFLUENCING OF THE RADIOSENSITIVITY AND MUTABILITY OF BARLEY. II. THE COMBINED EFFECTS OF X AND β RADIATION. Krausse, G. W. (Martin-Luther-Univ., Halle-Wittenberg, Ger.). Z. Pflantzenzuecht., 59: 137-62(Mar. 1968). (In German).

The action of the two mutagens, x rays and β radiation (^{32}P), was compared in experiments in which they were applied separately and in combination to caryopses of barley. Data are presented on the mutation rate and growth of seedlings and root length of the M_1 generation. (C.H.)

33795 CHANGES OF RADIOSENSITIVITY OF THE E. COLI K12 SLIME-PRODUCING MUTANT. Likhoded, L. Ya. (Gamaley Inst. of Epidemiology and Microbiology, Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol., No. 2, 72-6(Feb. 1968). (In Russian).

The properties of E. coli K12 slime-producing mutant were investigated. It was shown that the L muc. mutant had increased sensitivity to low uv doses and to γ-rays. Filamentous forms were produced in the cultures of the mutant under the influence of ultraviolet rays, radiomimetic agents and the agents interfering with cell wall synthesis. The capacity to repair uv irradiated phage was completely preserved in the mutant. Acriflavine increased the death of the uv irradiated cultures of the wild type and mutant strains to the same extent. The aforementioned data suggest that the mutant is harbouring an intact dark repair system and is one of the lon mutants. Possible mechanisms of increased uv sensitivity related to lon-gene mutations are discussed. (auth)

33796 RADIATION-INDUCED CYTOGENETIC DAMAGE IN THE HeLa CELL. Bushong, S. C.; Watson, J. A.; Wald, N. (Univ. of Pittsburgh). Radiology, 90: 958-61(May 1968).

HeLa cells were examined during the first mitosis following varying doses of 280 kVp x radiation for radiation-induced chromosome damage. The chromosome aberration frequency indicated a similar radiosensitivity, but a higher spontaneous aberration frequency than that reported for normal mammalian cells. (auth) (TSS)

33797 CHROMOSOMAL DISTURBANCES OCCURRING AFTER X-RAY EXAMINATION. Konstantinova, Bl. P.; Kasabov, L. L. Rentgenol. Radiol., 7: 4-10(1968). (In Bulgarian).

Somatic mutations occurring in a newborn in connection with x ray examination are reported. The child was born with severe malformations—inferior coelosomia, hermaphroditism, prolapse of the anus and rectum, ectopy of the urinary bladder and teratoma of the sacrococcygeal area. Urography was performed soon after birth to specify the state of the urogenital system. The child received 7 ml. opacuran and a total irradiation dose of 300 m R in three roentgenograms. The child was delivered from a first normal pregnancy; the parents were young; 21 and 26 years of age, with good housing conditions, and free of familial overburdening. During the 3rd to 4th month of pregnancy the mother has received a single dose of 2 coffenal tablets and after birth 2,300,000 U. of penicillin, 3 g of streptomycin and 9 dragees of metergin. The chromosomal analysis performed by the authors with peripheral blood of the child and the parents showed somatic mutations—21.2 percent in the child and 4 percent in the mother. The urographic examination is held responsible for the occurrence of somatic mutations in the child and the antibiotic treatment—in the mother. This communication is of interest being the first one of somatic mutations in a newborn child. (auth)

33798 RADIATION INDUCED PROGRESSIVE MUTANTS IN BAJRA (PENNISETUM TYPHOIDES STAPF AND HUBB.). Joshi,

M. G. (Indian Agriculture Research Inst., New Delhi). Curr. Sci. (India), 37: 235-6(Apr. 20, 1968).

Mutation experiments were undertaken in Pusa Moti, an improved variety of bajra (Pennisetum typhoides) in an attempt to effect certain changes in plant height and ear characters. Pure and dry seeds of this variety were irradiated with ^{60}Co γ rays. The LD-50 was determined by pilot experiments. This dose was near 25 kR. Seeds irradiated with 25 kR were shown in the field, M_1 plants were selfed, and M_2 generation was raised. Out of 215 lines of M_2 raised, eight segregated for chlorophyll mutations. Albina mutants proved lethal whereas striata ones developed into stunted plants. Three lines segregated for dwarfness having height range from 105 cm to 130 cm at maturity as against 200 cm of the parent. One line segregated for bristled ear mutants. Dwarf and bristled ear mutants were followed in M_3 and M_4. Plants with bristled ears and dwarf plants were the progressive macro-mutants obtained in this experiment. Such desired changes in an established variety increases the potentiality and thus the utility of the improved strain evolved thereby. (C.H.)

Health Physics and Safety

Refer also to abstracts 33399, 33668, 33715, 33778, 33890, 33904, 33915, 33983, 34728, 35562, and 35726.

33799 (A/AC.82/G/L–1181) NEKOTORYE RADIATSIONNO-GIGIENICHESKIE ASPEKTY MIKROKLIMATA STROENII. (Some Radiation Hygiene Aspects of the Microclimate of Structures). Pertsov, L. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 12p. (In Russian). Dep.

In countries with a bleak climate, such as the Soviet Union, the population spends up to 70% of its time indoors; therefore, the radiation effects of the microclimate within buildings are of great importance. Humans are thus subjected to ionizing radiation, the intensity of which depends on the terrestrial and cosmic components of the natural radiation field. Studies on the radiation burden of humans revealed that the radiation field is usually much higher inside of the buildings than outside. Of the three factors influencing the radiation field inside buildings, secondary cosmic radiation, γ emission of building materials, and radioactive aerosols, the first one is best known even though it is of extraterrestrial origin. Studies in the European portion of the Soviet Union indicated that the intensity of the γ radiation that is caused by the natural radioactive isotopes in the building materials is closely related to the geology of the area whence the materials were taken. The γ radiation in buildings of towns near magmatic granite rocks with a high natural radioisotope content is much higher than in population centers near sedimentary deposits. The γ irradiation of the inhabitants varies between wide limits; it may exceed occasionally the mean level, taken as 10 microR/hour. The aerosol concentration within buildings depends also on the compactness of the building materials; the more porous materials release more easily their radioactive emanations. (TTT)

33800 (A/AC.82/G/L–1182) RADIOAKTIVNOST TKANEI ZHITELEI OTDEL'NYKH RAIONOV SOVETSKOGO SOYUZA. (Radioactivity of Tissues of Inhabitants of Various Regions of the Union). Pertsov, L. A.; Popov, D. K.; Dzyubenko, I. I.; Ermolaeva-Makovskaya, A. P.; Ostryakova, N. I.; Perova, A. A.; Plotko, E. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 17p. (In Russian). Dep.

Biochemical and geochemical studies carried out during the last decade revealed that the natural radioactivity of the surface of the Earth varies from point to point; therefore, the cells of the flora and fauna, including humans, are affected by a constant but varying dose of ionizing radiation. The radiation affects the rate of mutation and in some cases, it may influence favorably the functions of subcellular substances. The contributions of the four chief natural radioactive elements, ^{40}K, ^{210}Po, ^{226}Ra, and ^{228}Th, and of the two most important artificial radioisotopes, ^{90}Sr and ^{137}Cs, to the body burden of the inhabitants living in various parts of the Soviet Union were investigated, using specimens obtained from district hospitals. The standard ^{40}K concentration was taken as 0.80 nCie/g. The data indicated that the radiation level due to natural and artificial radioisotopes acting on the human cells varies between wide limits; therefore, averaged values are of interest only for general studies. The ingested dose may vary as much as the external radiation dose of terrestrial and cosmic origin. It was concluded that additional body burden with dose rates not exceeding that of natural radioactive materials is not to be considered necessarily as being pathological from either somatic or genetic points of view. (TTT)

33801 (A/AC.82/G/L–1184) STRONTSII-90 V KOSTNOI TKANI NASELENIYA SOVETSKOGO SOYUZA. (^{90}Sr in the Bone Tissue of the Population of the Soviet Union). Marei, A. N.; Borisov, B. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 10p. (In Russian). Dep.

The characteristics of the changes in the content of ^{90}Sr in human bone tissue of the age groups 0 to 1 year, 1 year, 2 years, 3 years, 4 years, 5 to 19 years, and 20 years in the U.S.S.R. were evaluated for the years 1964, 1965, and 1966. The results are tabulated. (J.S.R.)

33802 (A/AC.82/G/L–1186) POSTUPLENIE STRONTSIYA-90 I TSEZIYA-137 S PISHCHEVYM RATSIONOM NASELENIYU SOVETSKOGO SOYUZA V 1965–1966 GG. V REZUL'TATE STRATOSFERNYKH VYPADENII. DOZY OBLUCHENIYA NASELENIYA SSSR OT STRATOSFERNYKH VYPADENII V 1964–1965 GG. (Intake of ^{90}Sr and ^{137}Cs With Food by the Population of the Soviet Union in 1965–1966 as the Result of Stratospheric Fall-Out. Radiation Doses of the Population of the USSR From Stratospheric Fall-Out in 1964–1965). Knizhnikov, V. A.; Petukhova, E. V.; Stepanov, Yu. S.; Barkhudarov, R. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 16p. (In Russian). Dep.

The results of the measurements of the ^{90}Sr and ^{137}Cs intake by the population of the USSR as a result of contamination of food and water by stratospheric fallout are reported and tabulated. The radiation dose was evaluated for children 1 to 4 years of age and for adults over 20 for the years 1964 and 1965. (J.S.R.)

33803 (A/AC.82/G/L–1190) STRONTSII-90 IN POLONII-210 V KOSTYAKH ZHITELEI KRAINEGO SEVERA V 1965 G. (^{90}Sr and ^{210}Po in the Bones of the Inhabitants of the Far North in 1965). Litver, B. Ya.; Moiseev, A. A.; Ramzaev, P. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 8p. (In Russian). Dep.

Radiochemical analysis of samples of bony tissues of 27 inhabitants of the Far North USSR showed that the content of ^{90}Sr in the bones studied in 1965 varied from 2.6 Ci/g of Ca to 26.8 pCi/g Ca. The mean ^{90}Sr content of the bony tissue of inhabitants of the north was four to six times higher than that of inhabitants of moderate latitudes. The tissue dose to the hematopoietic bone marrow was 2.4 to 24.2 mrad/yr. The mean content of ^{210}Po in the bone samples was 117 ± 21 pCi/kg untreated bone. The maximum content of ^{210}Po found in bone was 270 pCi/kg bone. The mean tissue dose to the bone marrow was 1.1 ± 0.2 mrad/yr. The correlation coefficient between the ^{90}Sr and ^{210}Po content of the bones of the inhabitants of the far north was 0.21 ± 0.29; therefore, it was concluded that the distribution of ^{90}Sr and ^{210}Po in the organism is controlled by different nutritive chains. (tr-auth)

33804 (A/AC.82/G/L–1193) SODERZHANIE TSEZIYA-137 I KALIYA U NASELENIYA SSSR V 1962–1966 GG. (Body Burden of ^{137}Cs and Potassium Among the Population of the USSR in 1962–1966). Belle, Yu. S.; Krisyuk, E. M.; Lebedev, O. V.; Shamov, V. P.; Shapiro, E. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 16p. (In Russian). Dep.

The results of an investigation of the incorporation of ^{137}Cs in the population of the USSR in 1962 to 1966 are discussed. In particular, the results of the determination of the half-life of elimination of ^{137}Cs are discussed. Data on the changes in the content, specific activity, and concentration per 1 g of K from 1962 to 1966, obtained by examination of more than 1000 persons, are given. The dependence of these parameters and of the K concentration on the age and sex of the person examined was investigated. It was shown that the distribution of K in homogeneous groups of men is described by a normal law and the distribution of ^{137}Cs by a logarithmic law. (tr-auth)

33805 (A/AC.82/G/L–1194) STRONTSII-90 V VODOROSLYAKH, TSVETKOVYKH RASTENIYAKH, MOLLYUSKAKH, RAKOOBRAZNYKH I RYBAKH CHERNOGO MORYA (1965–1966 GG.). (^{90}Sr in Seaweed, Aquatic Plants, Molluscs, Crustaceans, and Fish of the Black Sea (1965–1966)). Polikarpov, G. G.; Parchevskii, V. P.; Sokolova, I. A.; Kulebakina, L. G.; Bachurin, A. A.; Baranova-Ryndina, D. D.; Parchevskaya, D. S.; Zaburunnova, I. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 29p. (In Russian). Dep.

Data are reported from the systematic study of the changes in the concentration of ^{90}Sr in hydrobionts from year to year, its distribution between plants and animals, and the ratio of radioactive and stable Sr in sea plants and animals of the Black Sea in 1965 and 1966. (J.S.R.)

33806 (AECL–3063) ANALYSIS OF RADIATION EXPOSURES IN 1967. Bush, W. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1968. 16p. Dep. CFSTI. CAN.

Exposures to external beta and gamma radiation and to internal radiation from tritiated water (HTO) during 1967 are analyzed and compared with exposures in previous years. About 85% of the external and 100% of the internal exposure was received at CRNL, of which nearly 90% was received by operating, maintenance, and radiation control personnel, mostly in the NRX and NRU reactor buildings. The combined doses from external and internal exposures to the whole-body, eye, lenses, and skin, and their distribution amongst branches and individuals, are presented in graphical form. (auth)

33807 (AEEW-M-613(Rev.1)) PLUTONIUM-CONTAMINATED WOUND. Laylee, A. M.; Fraser, D. C.; Johns, T. F. (Atomic Energy Establishment, Winfrith (England)). Aug. 1966. 21p. Dep. CFSTI. UK.

The medical treatment of a lacerated wound on the dorsal surface of a worker's finger that was initially contaminated with about 100 mμCi of finely divided plutonium oxide is described. Results of the measurements that were made of the amount of plutonium remaining in the wound at various stages of the treatment and of the amounts removed are given. Measurements were also made of the plutonium in fecal samples taken during the period immediately following the accident and in the urine samples taken during the following four months. (auth)

33808 (BMwF-FBK-67-70) UEBER DIE KONTAMINATION MENSCHLICHER GEWEBE UND EINER STANDARDERNAEHRUNG MIT FALL-OUT-BESTANDTEILEN IN DER ZEIT VON 1958 BIS 1966. (Contamination of Human Tissue and a Standard Diet with Fallout Constituents from 1958 to 1966). Pribilla, O. (Kiel Univ. (West Germany). Institut fuer Gerichtliche und Soziale Medizin). Apr. 1, 1967. 29p. (In German). Dep.

Contamination of human tissues and a standard diet in Germany with fallout during the time from 1958 to 1966 is reported. Since 1958 the ^{90}Sr content of human bones of all age groups was investigated. The ^{90}Sr content of a standard diet was compared with that of placentae as well as bones of stillborns and other human tissues, and discrimination factors regarding standard diet and those samples were determined. Data are included on ^{137}Cs distribution in bones, blood, lungs, and muscles of the various age groups. (auth)

33809 (BNWL-SA-1509) POST ATTACK ACTIONS IN A NUCLEAR MASS DISASTER. Heid, K. R.; Carter, L. A.; Larson, H. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 27, 1968. Contract AT(45-1)-1830. 13p. (CONF-680507-2). Dep. CFSTI.

From Conference on Radiological Protection of the Public in Nuclear Mass Disasters, Interlaken, Switzerland.

Post attack actions may be defined as those actions necessary so that individuals, communities, and nations may return to a normal pattern of living following involvement in nuclear warfare. Actions pertaining to an individual who has taken shelter in a home or private shelter that does not have trained radiological leadership are discussed. Several possible sources of radiation resulting from fallout of radioactive debris and the contribution of each source to the total exposure of occupants in typical shelters are described. Suggested reasons for early exits from shelters and recommended activities outside the shelter at various times after the arrival of the fallout are offered. Techniques, methods, and timing of decontamination efforts to minimize the total exposure to occupants of home or private shelters are discussed. The effectiveness of individual efforts to reclaim large open areas such as farms, highways, stores, etc. is compared to the effectiveness of large scale reclamation procedures and techniques. The advantages of participating in planned group efforts for subsequent decontamination are stressed. (auth)

33810 (CEA-R-3382) ESSAI DE DETERMINATION DES CONCENTRATIONS MAXIMALES ADMISSIBLES POUR LES POUMONS. (Determination of Maximum Permissible Concentrations for the Lungs). Vacca, Georges (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1967. 66p. (In French). Dep.

The Task group of Committee II of the International Commission on Radiological Protection (I.C.R.P.) published in 1966 the results of its work on aerosol dynamics in the respiratory tract. A model was proposed for the deposition of dust in the lung and lymphatic nodes and for its clearance in the blood and/or in the gastrointestinal tract. The maximum permissible concentration values resulting from the application of such a model are presented for approximately 250 radioisotopes. (auth)(TSS)

33811 (COO-1733-2) THE TRANSFER OF ^{210}Po FROM CATTLE FEED TO MILK. Watters, Robert L.; McInroy, James F. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). [1968]. Contract AT(11-1)-1733. 15p. Dep. CFSTI.

Polonium-210 was proposed for use in radionuclide electrical generators in space missions. Accidental release of the quantities of this material required for such an application could lead to the contamination of large areas. One of the hazards of such an accident could be the transfer of ^{210}Po from contaminated dairy pasture to man through the milk supply. This study is an attempt to estimate the magnitude of this problem. With the use of assumptions regarding the feeding of cattle and the intake of milk by man an estimate of the surface deposition to produce a maximum permissible body burden is made. (auth)

33812 (NYO-2598-36) THE LOSS OF ORGANIC AND INORGANIC MATERIALS FROM ABOVE-GROUND PLANT PARTS, WITH ESPECIAL REFERENCE TO DECONTAMINATION OF PARTS UTILIZED FOR FOOD. Progress Report, June 1, 1967–May 31, 1968. Tukey, H. B. Jr. (Cornell Univ., Ithaca, N. Y. Dept. of Floriculture and Ornamental Horticulture). Mar. 26, 1968. Contract AT(30-1)-2598. 9p. Dep. CFSTI.

GIBBERELLINS — leaching from chrysanthemum plants, factors affecting
BIOASSAY — sensitivity of lettuce hypocotyl, for detecting gibberellin leaching from chrysanthemum plants, effects of light intensity on
CARBOHYDRATES — leaching from plants, effects of age of plants, light, nonionic surfactants, and temperature on
STRONTIUM-89 — leaching from beans, cucumbers, peas, and tomatoes, following uptake by leaves and roots
ROOTS — growth in dormant woody plants, effects of temperature on
FALLOUT — uptake by roots of dormant woody plants, effects of soil temperature on (H.G.D.)

33813 (NYO-3364-43) THE SEASONAL VARIATIONS IN THE ^{137}Cs-CONCENTRATIONS IN COW'S MILK, 1963–1967. [Stroemme, Aksel] (Norsk Radium Hospital, Oslo). Contract AT(30-1)-3364. 26p. Dep. CFSTI.

Data are tabulated on the ^{137}Cs content of milk samples collected from 30 dairies located in three zones of Norway. It was shown that the ^{137}Cs concentration: is rather steady and at a minimum during February, March, and April; increases from May to the August peak; and steadily decreases from August until early spring. Between 1963 and 1967, steady increases were observed up to the highest levels recorded, which were in 1965. The ^{137}Cs contamination of milk is almost exclusively a result of contamination of the cow's food, the content in grass being the determining factor. Correlation of ^{137}Cs concentrations in milk from spring samplings with total precipitation of the previous year indicates that deposition of the radionuclide on the green parts of the plants is more critical to plant uptake that soil concentrations. (H.G.D.)

33814 (ORNL-TM-2229) AGE-DEPENDENT MODELS FOR ESTIMATING INTERNAL DOSE IN FEASIBILITY EVALUATIONS OF PLOWSHARE EVENTS. Plowshare Research and Development Progress Report, October 1, 1967–April 1, 1968. Rohwer, Paul S.; Kaye, Stephen V. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 36p. Dep. CFSTI.

Age-dependent models are presented that are used in the INREM computer code for calculating the radiation dose for different age groups of the population resulting from inhalation or ingestion of radionuclides. Use of age-dependent models in feasibility studies permits identification of the critical segment of the population and provides the guidance necessary for planning of remedial action. Results of dose calculations are presented for tritium and ^{131}I to illustrate use of the INREM code. The radionuclide input used for the tritium example is based on estimated concentrations released to air after combustion of natural gas stored in the Project Ketch reservoir. The ^{131}I example illustrates the influence of the age-dependent parameters in the dose model upon the resulting dose estimates. (auth)

33815 (ORO-490-14) RADIOACTIVITY TRANSPORT IN WATER: NUMERICAL SOLUTIONS OF RADIONUCLIDE TRANSPORT EQUATIONS AND ROLE OF PLANTS IN ^{85}Sr TRANSPORT. Technical Report No. 14. Armstrong, Neal Earl; Gloyna, Earnest F. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). Jan. 1968. Contract AT(11-1)-490. 153p. (EHE-12-6703; CRWR-23). Dep. CFSTI.

The role of plants in ^{85}Sr transport in aquaria and a model river was examined, and a numerical solution to the dispersion equation with convection was derived and extended to include plant sorption. Using the macrophyte, Vallisneria americans Michanx, it was found that almost instantaneous equilibrium was reached with ^{85}Sr in solution through adsorption followed by a slower and more complete uptake by absorption. A characteristic pattern of uptake and release was observed after instantaneous releases into aquaria and at stations downstream from the point of release in a model river. Under continuous release, uptake tended toward an equilibrium level which was a function of the amount of attached algae present. It was concluded for conditions used in this study that plants played a negligible role in ^{85}Sr transport. The uptake of ^{85}Sr by plants after instantaneous release could be modeled using a sorption-desorption equation. Instantaneous dye and ^{85}Sr releases were made in the model river to determine the dispersion coefficient and tracer cloud velocity with the two station method using only a selected portion of the concentration-time curves. The cut-off point for this portion was the point where one-tenth the peak value was observed. Solutions of the numerical model using constants calculated in this manner gave better fit to the observed data than methods previously used. Constant release data could also be predicted with this model using revised initial conditions. A numerical solution to the equations relating dispersion to plant uptake was also derived but not extensively tested. It was concluded that numerical solutions hold more promise in this area than analytical solutions because of their versatility and ease of computation. (auth)

33816 (PHS-999-RH-28) FULL-SCALE SYSTEM FOR REMOVAL OF RADIOSTRONTIUM FROM FLUID MILK. Proceedings of Seminar, February 24-25, 1965. (National Center for Radiological Health, Rockville, Md.). 116p. Public Health Service, Washington, D. C. Free.

A seminar was held simultaneously with a demonstration of a full-scale system for removing ^{89}Sr and ^{90}Sr from fluid milk. The removal rate of the process was better than 90 percent. The taste of the treated milk compared favorably with regular milk. Nutritional values were altered somewhat, but animal feeding studies showed no deleterious effects on growth or general health as a result of known changes in the processed milk. The system included storage tanks, ion exchange resin columns, a high-temperature short-time pasteurizer, time and step controllers, and pH controls. Papers were presented on laboratory studies of ion exchange methods, nutritional investigation of milk processed in a pilot plant, microbiological aspects of the fixed-bed process, design and operation of full-scale equipment, problems associated with designing equipment, automation of full-scale equipment, problems associated with quality control and removal efficiency, relationship of the ion exchange process to present day commercial fluid milk processing operations, and additional research and development activities considered for treatment processes. (auth)

33817 (RA-32) ^{90}Sr AND ^{137}Cs IN THE HUMAN DIET IN THE NETHERLANDS DURING 1963. Mattern, F. C. M.; Drost, R.; Strackee, L. (Rijks Instituut voor de Volksgezondheid, Bilthoven (Netherlands). Laboratorium voor Stralingsonderzoek). Apr. 1968. 27p. Dep.

Results of measurements of ^{90}Sr and ^{137}Cs in a number of foodstuffs are reported. The yearly mean of the daily dietary intake of ^{90}Sr and ^{137}Cs in the Netherlands was estimated as 37.8 pCi/day and 212 pCi/day. The computation of the estimated values from the national food balance sheet is described in some detail. (auth)

33818 (UCLA-12-676) THE SEQUENTIAL SEPARATION AND QUANTITATIVE DETERMINATION OF ^{90}Sr, ^{144}Ce, ^{137}Cs AND THE STABLE ELEMENTS OF Sr AND Ca in PLANT, FECES, MILK, AND WATER SAMPLES. Wood, R. A.; Wakakuwa, S. T.; Rutherford, T. H.; Beck, A. L.; Roscoe, R. V. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Jan. 29, 1968. Contract AT(04-1)-Gen-12. 67p. Dep. CFSTI.

A method is described for the sequential separation and determination of ^{90}Sr, ^{144}Ce, ^{137}Cs and the stable elements of Sr and Ca in 100 to 500 gram plant or feces samples, 2000 to 5000 ml milk samples and 1 to 10 gallon water samples. Solubilization and radioexchange were initiated in plant and feces by pre-ashing at 430°C for eight hours and then completing the solubilization with nitric acid and hydrogen peroxide in the presence of the carriers and tracers. Milk samples were concentrated by evaporation in the presence of 1 : 9 acetic acid and ashed at 430°C for eight hours. Solubilization was completed as in plant and feces samples. Water samples were filtered, the insoluble material was separately solubilized, recombined with the sample and evaporated to salting in the presence of nitric acid, carriers, and tracers. Water was added in excess. The final digestion of any remaining organic material was completed using nitric acid and hydrogen peroxide. The alkaline earths plus cerium were separated from the alkali metals as hydroxides and carbonates. The cesium was separated, concentrated and purified using ion exchange techniques. The strontium was separated from calcium and cerium by successive 75% nitric acid precipitations. Cerium was separated and concentrated using iodate methods or by liquid extraction using Bis (2-ethylhexyl) hydrogen phosphate. The cerium was purified and counted as the oxide. The strontium was set aside for 14 days. The ^{90}Sr was determined from its ^{90}Y daughter. The techniques and methods described in the procedure were developed or are standard procedures that were modified to meet the specific needs of the various Division research programs. This procedure thus represents the accumulative experience of this Laboratory in the processing and analysis of several thousand low activity plant, milk, feces and water samples for ^{90}Sr, ^{144}Ce, ^{137}Cs and the stable elements of Sr and Ca. The procedures and methods described were modified from existing published methodology and no claim is made or implied that these methods were or are the original development of the authors. The primary value of this procedure is that it was used with a large number of samples since 1963 and that semi-technical personnel can employ it and obtain good results. (auth)

33819 (UCRL-50387) ANALYSIS OF THE CARCINOGENIC RISK FROM AN INSOLUBLE ALPHA-EMITTING AEROSOL DEPOSITED IN DEEP RESPIRATORY TISSUE. Geesaman, Donald P. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 9, 1968. Contract W-7405-eng-48. 19p. Dep. CFSTI.

Pulmonary deposition and clearance are described; and relevant times, lengths and geometries are noted in order to construct a simple model of deep respiratory tissue. $^{238}PuO_2$ and $^{239}PuO_2$ are taken as representative aerosols in making quantitative estimates of tissue exposure and response. While no realistic evaluation of the total carcinogenic risk is accomplished, the results are such as to clarify the nature of the problem. In particular, if the loss of mitotic competence by a local cell population is sufficient to guarantee no origin of cancer within that population, then the carcinogenic risk from particulate sources does not scale to the total energy dissipated. To say what dose characteristics are significant to the risk would require an accurate knowledge of clearance, local shielding responses, and the mechanisms of cancer induction. In the absence of this detailed knowledge the suggested course is an experimental determination of the number of source particles per induced cancer. (auth)

33820 UMWELTRADIOAKTIVITAET UND STRAHLENBELASTUNG. BERICHT II/67. (Environmental Radioactivity and Radiation Burden. Second Quarterly Report, 67). Bad Godesberg, Ger., Bundesminister fuer Wissenschaftliche Forschung, 1967. 180p. DM 11,-.

The content of radioactive materials in the air, water, soil, and foodstuffs and the radiation burden of the population in the German Federal Republic measured during the second quarter of 1967 are reported in graphic and tabular form. (H.L.W.)

33821 ESTIMATION OF RADIATION DOSES TO THE RESPIRATORY TRACT FROM INHALATION OF AIRBORNE RADIOACTIVITY. Shleien, Bernard; Wall, Mary A.; Lutz, David (Northeastern Radiological Health Lab., Winchester, Mass.). Environ. Sci. Technol., 2: 438-43(June 1968).

A graded filtration sampler developed to estimate the respiratory deposition of airborne fallout provides information which when used with a suitable lung model permits estimation of the radiation dose to the nasopharyngeal, tracheabronchial, and pulmonary regions of the adult respiratory tract. Estimated doses to adults from airborne fallout collected in November 1966 and January 1967 were 85 and 130 microRem per 70 years to the nasopharyngeal and pulmonary regions of the respiratory tract, respectively. Estimated radiation dose to the tracheobronchial region was less than 0.01 microRem per 70 years. A dose of 225 microRem per 70 years to the thyroid gland was estimated due to inhalation. The greatest single dose commitment from fresh fission products was to the respiratory lymphatic nodes due to inhaled ^{144}Ce and ^{144}Pr. This was approximately 40 times the pulmonary region dose. Among long-lived radionuclides, ^{239}Pu delivered the greatest dose to the respiratory lymph nodes. Doses to the respiratory tract from the levels of airborne fresh fission products encountered in this study are low when compared with nonoccupational radiation doses due to inhaled radon and its short-lived daughters. This approach to estimation of respiratory doses is applicable to monitoring of nuclear facilities for airborne particulate hazards evaluation. (auth)

33822 YIELD, ENERGY, AND ANGULAR DISTRIBUTIONS OF NEUTRONS PRODUCED IN GRAPHITE, COPPER, AND TANTALUM TARGETS IRRADIATED WITH 63-MeV PROTONS. Johnson, D. R.; Ohnesorge, W. F. (Oak Ridge National Lab., Tenn.). Atompraxis, 14: 181-3(Apr.-May 1968).

Thick graphite, copper, and tantalum targets were irradiated with 63-MeV protons. Yield, energy, and angular distributions of the neutrons produced were determined using threshold detector techniques. The results indicate that the neutron energy spectra increase from 1 to 4 MeV and decrease at upper energies with a 1/E tail. Neutron yield increases exponentially with atomic weight of the target material whereas the neutron energy spectra and angular distributions become progressively softer and more isotropic, respectively. A maximum yield of 5.0×10^{10} neutrons/sec-μa-steradian (0°) was obtained with the tantalum target. (auth)

33823 QUANTITATIVE EVALUATION OF TRITIUM IN AUTORADIOGRAPHY AND BIOCHEMISTRY. Pelc, S. R.; Welton, M. G. E. (Medical Research Council, London). Nature (London), 216: 925-7(Dec. 2, 1967).

On account of the low energies of the β-particles emitted by tritium, absorption even in very thin layers of organic material must be taken into account. Calculations are presented of the β-particle absorption within a layer incorporating tritium, and in a superimposed layer of organic material. For a biological specimen the absorption can be taken as proportional to density. The emission spectrum of tritium was computed using a nuclear Coulomb factor evaluated from NBS tables, and the average kinetic energy was calculated as 5.7 keV, with a peak at 2.3 keV. The percentage of particles traversing a given thickness of material, and their emergent energies, were estimated, and a series of calculations made for an evenly loaded layer covered by an unlabeled layer. The computed results for the percentage of emerging β-particles agreed well with experimental results. A model is proposed in order to estimate the influence of different distributions of tritium within a structure, such as a cell. (UK)

33824 RADIATION HAZARD CONTROLS IN URANIUM MINES. Com. Naz. Energ. Nucl., Notiz., 14: 97-102(Jan. 1968). (In Italian).

The Public Health Service of the United States in collaboration with the A.E.C. and other government agencies developed guidelines for the control of radiation hazards in uranium mines. The environmental conditions in uranium mines are outlined, and the biological effects from exposure to radon and its decay products are summarized. The basic safety standards proposed are given. (J.S.R.)

33825 AGE DETERMINATION OF DEER ANTLERS. Geilmann, Wilhelm (Univ., Mainz). Z. Anal. Chem., 235: 172-6 (1968). (In German).

The content of ^{90}Sr in deer antlers was determined and used for dating the year of their growth. Techniques of ashing deer antlers for chemical analyses are described. Determinations of calcium and ^{90}Sr were made and results are tabulated. The deer antlers were classified into two groups: growth before 1952 to 1954 and growth after 1952 and 1954. The antlers formed before 1952 to 1954 could not be accurately dated because of the lack of ^{90}Sr. (H.L.W.)

33826 RADIOPHARMACEUTICAL DOSIMETRY IN PEDIATRICS. Kereiakes, James G.; Wellman, Henry N.; Tieman, Jeannine; Saenger, Eugene L. (Univ. of Cincinnati. National Center for Radiological Health, Cincinnati). Radiology, 90: 925-30(May 1968).

The average radiation doses to whole body and to certain organs were calculated from whole-body counter measurements for a selected population of children administered radiopharmaceuticals for diagnostic purposes. The pharmaceuticals were labeled with ^{47}Ca, ^{131}I, ^{51}Cr, ^{59}Fe, ^{197}Hg, or ^{85}Sr. The thyroid uptake studies and dose calculations, collated with the findings of other investigators, suggested that ^{131}I thyroid tests for suspected disease in newborns, e.g., cretinism and inborn errors of thyroid metabolism, be made at least one to two weeks following birth unless the diagnosis becomes a life-saving procedure. The observations concerning other radionuclides indicated that both whole-body and organ doses did not exceed those expected and that these labeled pharmaceuticals could be used in their accustomed doses safely in children. The findings presented here are part of a continuing program for obtaining metabolic data in children to allow modifications of the dose calculations presented here and in previous reports and to provide more accurate and complete estimates of radiation exposure. (auth)

33827 THE EFFECTIVE ATTENUATION IN WATER OF THE GAMMA RAYS OF ^{198}Au, ^{192}Ir, ^{137}Cs, ^{226}Ra, AND ^{60}Co. Meisberger, Leo L.; Keller, Ronald J.; Shalek, Robert J. (Univ. of Texas, Austin. Anderson Hospital and Tumor Inst., Houston, Tex.). Radiology, 90: 953-7(May 1968).

The attenuation in water of the γ rays of ^{198}Au, ^{192}Ir, ^{137}Cs, ^{226}Ra (in equilibrium with daughter products), and ^{60}Co was measured experimentally and compared with calculations of the transport of γ rays in water and air. From the experiments and calculations, that were in reasonable but not perfect agreement, the ratio of absorbed dose in water compared to that in air was derived for each type of source for distances of 1 to 10 cm from point sources. A third order polynomial was fitted in each case for this ratio related to distance. Effects of γ attenuation in water on the dose from γ sources used for interstitial or intracavitary therapy are discussed. (auth) (TSS)

33828 A CALCULATION OF THE PHYSICAL CHARACTERISTICS OF NEGATIVE PION BEAMS: ENERGY-LOSS DISTRIBUTION AND BRAGG CURVES. Curtis, Stanley B.; Raju, Mudundi R. (Univ. of California, Berkeley). Contract W-7405-eng-48. Radiat. Res., 34: 239-55(1968). (UCRL-17606).

Calculations have been made of the dE/dx distribution (LET spectrum) and central-axis depth-dose curves (Bragg curves) of stopping negative pion beams in water. Such beams are of interest because of the large deposition of energy at depth in the stopping pion region relative to that deposited at the surface. Nuclear interactions occurring when the pions come to rest cause low-energy highly ionizing particles to be emitted as the capturing nucleus breaks up, thus increasing the dose deposited in the stopping pion region. The calculations show that, for beams similar to those presently available experimentally, peak depth-to-entrance ratios of 3.4 and 2.9 can be expected in the absorbed dose in water for pure and contaminated beams, respectively, with a width of around 3.5 cm. The contaminated beam was assumed to contain 65% pions, 10% muons, and 25% electrons. The pions in these beams have a range of 25 cm of water. Comparison with experimental results taken with a lithium-drifted silicon detector shows that this detector gives a reasonable picture of the relative doses in water, and so can be used to measure isodose distributions and Bragg curves in water phantoms. (auth)

33829 POSSIBILITY OF REDUCTION OF THE HAEMOPOIETIC BONE MARROW DOSE IN STANDARD RADIOGRAPHIC CHEST EXAMINATION. Romanini, A.; Colagrande, C. (Univ., Cattolica, Milan). Med. Nucl. Radiobiol. Lat., Suppl. 1, 625-34 (1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Data resulting from radiation doses to the hematopoietic bone marrow of the population during the radiological examinations are briefly described. The observation that about 50% of such doses were administered during x-ray examination of the chest that was far the most frequent, suggested that measures be taken to reduce this amount. Reference is made to results of accurate dosimetric studies in evaluating the amount of the dose absorbed with common radiographical techniques. Radiographic results and their applicability in ordinary radiodiagnosis, are critically examined. (auth)

33830 DOSIMETRY AND PROTEXIMETRY IN NEURORADIOLOGY. Giordano, G. B.; Golfieri, G. (Univ., Bologna). Med. Nucl. Radiobiol. Lat., Suppl. 1, 603-13(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Isoexposure charts were set up to record automatically the extent of diffused radiation to which an unprotected operator in a particular zone of the x ray room was exposed. During various neuroradiological examinations the dose to the patient's surface and gonads was measured; specially constructed phantoms were used. The ratio of deep transmission of different radiant energies in the cranium was also calculated. (auth)

33831 POSSIBLE RADIATION HAZARDS FROM RADAR STATIONS. Koerner, H. J. Zentralbl. Arbeitsmed. Arbeitsschultz, 17: 1-5(Jan. 1967). (In German).

In order to clarify the nature of the problem involved, the author begins by briefly describing the design and mode of operation of modern radar stations. The possible hazards from high-frequency fields and ionising radiation are then considered and protective measures discussed. (auth)

33832 NORME REPUBLICANE DE PROTECTIE A MUNCII. (Republican Standards for Worker's Protection). Bucarest, Comitetul de Stat Pentru Protectia Muncii, Ministerul Sanatatii si Prevederilor Sociale, 1966. 262p.

The various sections of these general occupational safety and health regulations, issued pursuant to article 4 of Act No. 5/1965 on Workers' Protection (see CIS 1162-1966, Vyz (622)), cover: general provisions; industrial buildings and halls; safety engineering (research, planning, design and use of tools, machines and installations); loading, unloading, conveying, handling and storage of materials; installations under pressure; hand tools; electrical installations and equipment; excavation work; microclimate, ventilation and heating; occupational health standards; prevention of diseases and accidents caused by gases, vapors or dusts; fire protection; ionizing radiation; lighting; noise and vibration; personal protection; first aid; medical examinations; safety training; safety campaigns; final provisions. (Occup. Safety and Health Abstr.)

33833 JAHRESBERICHTE DER GEWERBEAUFSICHT: BUNDESREPUBLIK DEUTSCHLAND, 1965. (Annual Reports of the Industrial Inspectorate: Federal Republic of Germany, 1965). Bonn, Bundesministerium fuer Arbeit und Sozialordnung, 1967. 832p.

A collection of annual reports of the Regional Industrial Inspectorates of the Federal Republic of Germany is arranged under the following headings: statutory provisions enacted in 1965 in the field of occupational safety and health; accident prevention, protection against fire and explosions; industrial organization and hygiene; health protection; radiation protection; environmental protection; enforcement of provisions on working hours; additional protection for special categories of persons. The individual sections contain numerous examples of actual accidents and safety measures applied in practice. Statistical tables are given at the end of each report regarding plant inspections, complaints lodged, warnings, summonses and penalties, and investigations of occupational accidents and diseases. Statistics for the Federal territory as a whole, and a subject index, conclude the work. (Occup. Safety and Health Abstr.)

33834 ANWEISUNG UEBER DIE EINFUEHRUNG UND ANWENDUNG ARBEITSHYGIENISCHER NORMEN. (Instruction Concerning the Introduction and Implementation of Occupational Health Standards). Berlin, Verfuegungen und Mitteilungen des Ministeriums fuer Gesundheitswesen, 1966. 23p.

New standards are laid down for the evaluation of workplaces, processes and production shops. Appendices contain the relevant occupational health standards relating to the following: measurement and evaluation of maximum concentrations of toxic dusts, gases and vapors at workplaces (threshold limit values); measurement and evaluation of non-toxic dust concentrations at workplaces; measurement and evaluation of maximum allowable radiation doses at workplaces. (Occup. Safety and Health Abstr.)

33835 THE RAPID DETERMINATION OF IMPORTANT RADIONUCLIDES ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs IN FOODSTUFFS AND WATER. II. PROCEDURES. Deut. Lebensm.-Rundsch., 60: 207-10(1964). (In German).

Detailed procedures for estimation of ^{89}Sr, ^{90}Sr, ^{131}I, and ^{137}Cs in typical foodstuffs such as rye and milk, and in water were presented. Concentrations of ^{89}Sr, ^{90}Sr, and ^{137}Cs in these substances for the year 1963 were tabulated. For rye the concentration ranges were from 1300 to 1600 pCi/Kg for ^{89}Sr, 500 to 600 pCi/Kg for ^{90}Sr, and 2100 pCi/Kg for ^{137}Cs. In milk the ^{90}Sr concentrations were 500 pCi/Kg, and 2600 pCi/Kg for ^{137}Cs. Step by step procedures for separation and estimation of ^{131}I and ^{89}Sr and ^{90}Sr in fresh milk were given. Details of instrumentation and mathematical procedures for calculation of the results were presented. Principles of γ spectroscopy of ^{131}I, ^{137}Cs, ^{140}Ba–^{140}La, and ^{40}K were briefly outlined for measurements to be made in milk. (BBB)

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Refer also to abstracts 33645, 33655, 33743, 33826, 33904, 33905, 33923, 33927, 33934, and 33936.

33836 (BMwF-FBK-67-85) WIRKUNG VON ROENTGENSTRAHLEN AUF ENZYME DES OESTROGENSTOFFWECHSELS IN VITRO. (Effects of X Rays on Enzymes of Oestrogen Metabolism In Vitro). Dahm, K.; Breuer, H. (Bonn Univ. (West Germany). Abt. fuer Klinische Chemie und Biochemie). Oct. 1967. 19p. (In German). Dep.

X rays were shown to have different effects on the activity of oestradiol 17-β-dehydrogenase that catalyses the oxidation of oestradiol-17-β to oestrone in various rat liver preparations. The enzyme was activated in tissue slices and the cytoplasmic fraction by 50,000 R and in the microsomal fraction by 500 R. Higher doses led to a loss of the activity of the enzyme. Kinetic studies were carried out with the microsomal oestradiol 17-β-dehydrogenase. The enzyme could not be reactivated by the addition of SH-containing compounds. When NAD was added before irradiation, it exerted a protective effect against inactivation; NADP had no effect. (auth)

33837 (JPRS-41315, pp 26-35) USE OF ULTRAVIOLET RADIATION FOR HYGIENIC AND THERAPEUTIC–PROPHYLACTIC PURPOSES. Dantsig, N. M.; Gorkin, Z. D.; Galanin, N. F. Translated from pp 203-11 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966.

A review is presented of symptoms and diseases resulting from lack of ultraviolet radiation of the sunlight. The importance of vitamin D deficiency in these diseases is pointed out. The problems of compensating for the lack of natural light are discussed. The use of the fotarity, an instrument for ultraviolet irradiation of underground workers, is discussed. Following use of this instrument, a reduction of the morbidity of workers with respect to bronchitis, influenza, and rheumatism was noted. Effects of ultraviolet radiation on the skin, the endocrine system, the central nervous system, and immune reactions are reviewed. Prophylaxis of anthracosis and silicosis by the use of ultraviolet radiation is discussed. (H.L.W.)

33838 (LA-DC-9402) POSSIBILITIES AND ADVANTAGES OF USING NEGATIVE PIONS IN RADIOTHERAPY. Rosen, Louis (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 3p. (CONF-680601-13). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

Recent advances in accelerator technology make possible the attainment of very high-intensity beams of protons for providing negative pions for radiotherapy. Unique properties of negative pions that make them useful for the treatment of inoperable tumors are discussed. A graph is presented to show comparisons of the efficacy of negative pion beams with that of x rays, γ rays, ^{4}He, ^{20}Ne, ^{40}Ar, and ^{56}Fe. (H.L.W.)

33839 (UCLA-12-640, pp 1-30) NUCLEAR MEDICINE. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

BLOOD PRESSURE—elevation in lungs of dogs, effects of isoproterenol on
LUNGS—distribution of inhaled aerosols in, effects of embolism on
BLOOD—circulation in brain, liver, lungs, spleen, and subarachnoid space, scanning of
ALBUMINS—preparation of iodine-125- and iodine-131-labeled macroaggregates of
RADIOISOTOPE SCANNING—methods for evaluation of blood circulation in brain, liver, lungs, and spleen using
DISEASES, PHYSIOLOGICAL—embolism, radiodiagnosis of lung, in man; emphysema, radiodiagnosis of pulmonary, in man; metabolic, radiodiagnosis of protein, in children, use of iodine-131-labeled albumin and whole body counting for
RADIATION DETECTORS, SCINTILLATION—performance of multi-probe, for rapid scanning of human organs
KIDNEYS—radioisotope function tests for human
DISEASES, NEOPLASTIC—malignant, fluorine-18 uptake by tissues of, in mice; lymphoma, incidence in mice following injection of cell-free supernatant from cultured tissues of virus-induced lymphomas
BONES—scanning, use of bromine-82, calcium-47, fluorine-18, and strontium-85 as tracers for
ANTIGENS—formation of tumor-specific, in mice with spontaneous and virus-induced leukemia
MICE—lymphoid tissue development in neonatally thymectomized, effects of thymus grafts on (C.H.)

33840 COMPARATIVE STUDIES OF COLLIMATOR PERFORMANCE OF TWO SCINTIGRAPHICAL APPLIANCES BY "LINE SPREAD FUNCTION" MEASUREMENTS. Zeidler, U.; Hundeshagen, H.; Feuerhake, I.; Creutzig, H. (Medizinische Hochschule, Hanover). Atompraxis, 14: 184-7(Apr.-May 1968). (In German).

Measuring the line spread function in different distances gives rapid information about collimator performance. Interesting parameters for evaluation and comparison as plane sensitivity, depth response and resolution are obtained in digital form by means of a 4096 channel analyzer adjusted to the scanners. Studies of collimators of two moving detectors (Magnascanner V and Dynapix) reveal comparable resolution and depth response and different plane sensitivity. (auth)

33841 PROTECTIVE EFFECT OF MEG, AET, SEROTONIN, AND PHENYLEPHRINE AGAINST BONE MARROW INJURY FOLLOWING WHOLE-BODY IRRADIATION OF MICE. Nakatsuka, Haruo; Ochi, Hironobu (Osaka City Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: No. 8, 993-8(Nov. 1966). (In Japanese).

The protective effects of MEA, AET, serotonin, and phenylephrine on bone marrow injury following whole-body irradiation of mice were studied. The nucleated cell count femur bone marrow of mice was used as a measurement of the bone marrow damage. The MEA, AET, serotonin and phenylephrine had a marked protective effect and gave dose reduction factors ranging from 1.5–2.5. These compounds also markedly enhanced the recovery of the bone marrow damage. (NSA of Japan)

33842 EFFECT OF CORTICOIDS ON THE SURVIVAL OF THE ANIMALS IRRADIATED WITH SUPRALETHAL DOSE. Zseboek, Z.; Baumgartner, E.; Janossy, Gy. Magy. Radiol., 19: 259-65 (Oct. 1967). (In Hungarian).

Irradiation with supralethal doses (1300 R) caused earlier death in adrenalectomized animals than in control animals. It was thought that this was due to the lack of secretion of glucocorticoids. However, results of substitution experiments and of treatment with spirolactone revealed that cessation of secretion of mineralocorticoids did not influence the survival of the animals suffering from the gastrointestinal syndrome. The beneficial effect of cortisone was observed not only in adrenalectomized animals, but also in irradiated animals having intact adrenal glands. (TSS)

33843 PHOTOTOXIC REACTIONS INDUCED BY HIGH DOSES OF CHLORPROMAZINE AND THIORIDAZINE. Satanove, Abraham (Provincial Mental Hospital, Essondale, Can.); McIntosh, John S. J. Amer. Med. Ass., 200: 209-12(Apr. 17, 1967).

Exposure to uv light resulted in phototoxic reactions to phenothiazine drugs in studies on 22 human subjects. These studies were done to determine the wavelength of the uv light necessary to produce a reaction, to determine the protection afforded by various sunscreen preparations, and to determine whether patients receiving large doses of phenothiazine derivatives were more reactive to uv light than those receiving lower doses. Also, studies were done to determine if there was a critical daily dose level necessary to produce this phototoxic reaction. After a 5-min exposure in the 22 patients tested with various light filters, a reaction was noted in all subjects at the site of the control and at the site of the filter that passed light from 2400 to 4000 Å (Corning 7-54). The sites covered by the filter with a transmission range of 3200 to 3900 Å (Corning 7-39) showed no reaction. This narrowed the region of active wavelengths to the interval of 2400 to 3200 Å in all cases. In four patients tested there was also a reaction (to a lesser degree) at the sites where a window glass and filter that transmitted wavelengths longer than 4100 Å (Corning 3-73) were used. Common sunscreen preparations such as those containing aminobenzoic acid or titanium dioxide, or both, when properly applied, afforded protection to patients receiving chlorpromazine but pigmentation developed in some patients treated with thioridazine. Patients receiving 600 mg or more of chlorpromazine-HCl, with two exceptions, reacted to exposure of uv light in less than 60 sec. (BBB)

33844 ACTION OF A THYMIC EXTRACT ON RADIATION DISEASE IN SPLENECTOMIZED RATS. Gheorghe, N.; Lupu, I.; Cavulea, O.; Radulescu, C. Radiobiol. Biol. Mol., 63-8(1967). (In Rumanian).

The early administration of a thymic extract, associated with penicillin and streptomycin, in rats exposed to a LD100 radiation dose for 20 days led to a survival rate of 14 rats out of 20. Splenectomy performed 10 days prior to irradiation delayed the therapeutic efficiency of the antibiotics-associated thymic extract in radiation disease. (auth) (Romanian Sci. Abstr.)

33845 PROTECTIVE AND THERAPEUTIC EFFECT OF CEPHARANTHINE IN RADIATION INJURY. Shimizu, Yusuke; Kamachi, Sachihiro (Kobe Medical Coll., Japan). Jibiinkoka Rinsho, 58: 641-4(Sept. 1965). (In Japanese).

The protective and therapeutic effect of cepharanthine on leukopenia induced by the radiotherapy or the administration of cancerostatic substance was studied clinically employing patients with tumor in the head and neck. Five patients were not administered cepharanthine (control group), 11 patients were given the drug after the radiation treatment was finished, and 10 patients were given the drug when the radiation treatment was started. Cepharanthine was administered mainly intravenously and sometimes intramuscularly, with the daily dose 10 mg. The number of leukocytes was counted every 10 days. In the treated group in which the recovery from leukopenia after radiation treatment was studied, the recovery was rapid compared with the control group. In the group, administered the drug when radiation treatment was begun, to prevent leukopenia, the decrease of leukocyte counts was low and recovery after the treatment was rapid, compared with the control group. In 15 of 21 cases treated, cepharanthine was effective, either the number of leukocytes being increased, or the decrease of leukocyte count was prevented. The side effect observed was pain and an induration at the intramuscular injection sites, but this was prevented by changing from the intramuscular to intravenous injection. (NSA of Japan)

33846 OPTIMAL RADIOIODINE TREATMENT OF BASEDOW'S DISEASE. Fazakas, S. Magy. Radiol. 19: 276-82(Oct. 1967). (In Hungarian).

From the point of view of radioiodine treatment the patients suffering from Basedow's disease may be subdivided into a sensitive and a resistant group. For the successful treatment and recovery of the latter more than double the quantity of radioiodine is necessary than for that of the patients of the first group. During the so-called adapted therapy satisfactory results were obtained even with considerably smaller doses than usual. These small doses, however, are efficacious only in sensitive patients; in resistant ones they produce no effect. Higher doses signify unnecessary overload for the sensitive patients. Optimal dose seems to be 60 μCi/g in thyroid dose, or its equivalent. (auth)

33847 DIAGNOSIS OF BONE DISEASES WITH ^{85}Sr. Glauber, A.; Lenart, Gy.; Arky, I. Magy. Radiol., 19: 283-7(Oct. 1967). (In Hungarian).

In tumorous and non-tumorous bone diseases the diagnostical possibilities offered by ^{85}Sr were examined. The measurements performed on the tumorous tissue, excised during surgical intervention and on the bony surroundings revealed that the isotopic enrichment occurred not in the tumorous tissue itself, but in its surroundings. (auth)

33848 CORRELATION BETWEEN CHANGES IN RADIATION SENSITIVITY AND THE LEVEL OF ENDOGENIC THIOL GROUPS UNDER THE EFFECT OF RADIOPROTECTIVE AGENTS. Graevskii, E. Ya.; Konstantinova, M. M.; Nekrasova, I. V.; Sokolova, O. M.; Tarasenko, A. G. (Inst. of Animal Morphology, Moscow). Radiobiologiya, 7: 130-2(1967). (In Russian).

The effects of 5-methoxytryptamine (1.4 mg), serotonin (2.1 mg), cysteamine (3 mg), and cystamine (5 mg) on the level of SH groups and the content of O_2 in the spleen of mice irradiated with 900 R of γ rays were investigated. During a period of two hours after subcutaneous injection of these substances, a clear correlation between the level of SH groups in the spleen and the resistance of the mice to radiation, as indicated by the rate of survival for 30 days after irradiation, was observed. The maximum increase in resistance under the action of the protective substances was reached approximately 30 min after the injection. While a correlation between the protective effect and the level of SH groups was observed for all four substances, the protective effect was correlated with the content of O_2 in the spleen only for the indolylalkylamines. (JPRS)

33849 ^{90}Sr TREATMENT OF HEMANGIOMA IN CHILDHOOD. Glaser, F. H. Magy. Radiol., 19: 270-5(Oct. 1967). (In Hungarian).

On the basis of 197 irradiated and control cases it was concluded that the beta radiation treatment of hemangioma in childhood is very useful and advantageous in respect both to dosage and protection against radiation injuries. (auth)

33850 THE INFORMATION RETRIEVAL SYSTEM, IRABS-1, IN THE RESEARCH INSTITUTE OF NUCLEAR MEDICINE AND BIOLOGY, HIROSHIMA UNIVERSITY. Watanabe, Mineo (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 8, 131-47 (1967). (In Japanese).

Information Retrieval for Atomic Bomb Survivors, version 1 (IRABS-1) is an information retrieval system that is being developed at the Institute. Some of the characteristic specifications of the system are described as follows: The file format as required is formal; the retrieve items are chosen from 50 predefined items; the logical formula for retrieval can be designated in three formulas in the order of required weighting on request (one logical formula cannot contain over 15 retrieve items and over 20 retrieve items cannot be contained in three logical formulas); the retrieved information may output through line printer, card puncher, paper tape puncher, or magnetic tape handler (the retrieved file can be output through combinations of these machines); and the retrieval time for a moderate request is five minutes (30,000 record file). (auth)

33851 RADIOPROTECTIVE EFFECT OF WISTARIA DURING X RAY IRRADIATION. RADIOPROTECTION RELATIVE TO THE TIME OF WISTARIA ADMINISTRATION. Ghizari, E. Fiziol. Norm. Patol., 13: 165-9(1967). (In Rumanian).

The radioprotective effect of wistaria on inorganic adenosintriphosphatase (ATP-ase) and pyrophosphatase (PP-ase) in mouse liver relative to the time of administering the radioprotecting substance was studied. It was found that the optimal time for wistaria administration by intraperitoneal injections was three hours before irradiation. (auth)

33852 CONTRIBUTION TO THE STUDY OF THE INFLUENCE OF β-METHASONE-17-VALERATE ON IRRADIATED SKIN. Orlandini, I.; Azzoni, G. (Istituti Ospedalieri Carlo Poma, Mantova, Italy). Minerva Radiol., Fisioter. Radiobiol., 12: 287-91 (July-Aug. 1967). (In Italian).

Experimental research was carried out by irradiating the skin of young pigs. Two fields of irradiation were fixed, one on the shoulder where roentgen therapy was associated with local treatment with β-methasone-17-valerate, and the other at the homolateral buttock where roentgen irradiation alone was performed. Iconographic documentation showed a sharp difference in behavior between the cutaneous lesions with regards to both time of onset and the repair process. The clear reduction in inflammatory phenomena in the skin treated with the steroid right from the beginning of roentgentherapy made it possible to distribute high doses of radiations. From personal experience the usefulness of steroids topical treatment was evident in all those cases where the tissue radioresistance threshold has to be raised. It was also clear that this treatment should be begun at the same time as the radiant treatment. (auth)

33853 PROTECTION OF ESCHERICHIA COLI AGAINST RADIATION DAMAGE BY 2-METHYL-1,3-CYCLOHEXANEDIONE

AND SOME RELATED COMPOUNDS. Pittillo, Robert F.; Lucas, Mary B. (Southern Research Inst., Birmingham, Ala.). Radiat. Res., 34: 79-86(1968).

2-Methyl-1,3-cyclohexanedione was found to protect Escherichia coli against both the inactivating effects of ultraviolet light and ^{60}Co-induced lethality. Of a number of structurally related compounds tested, only 1,3-cyclohexanedione and 5,5-dimethyl-1,3-cyclohexanedione protected Escherichia coli against radiation effects. The mechanism(s) by which the compounds acted are not discussed. (auth)

33854 SECONDARY DISEASE OF RADIATION CHIMERA. Zaitseva, K. K. Arkh. Patol., 29: 3-11(1967). (In Russian).

A literature survey of the secondary disease of radiation chimera is presented. This affection is regarded as a new nosological form, the occurrence of which is associated with one of the most effective therapeutic methods of acute radiation sickness—bone marrow transplantation. Considerable attention is paid to the problems of pathological anatomy of the secondary disease; also cases of this disease in man are described. An inadequate efficiency of the existing means of reduction of the secondary disease is pointed out. Overcoming the secondary disease is regarded as one of the most important aspects of the problem of transplantation of an antigenically foreign hemopoietic tissue. (auth)

33855 PROCESS FOR THE PROTECTION OF ORGANIC MATERIALS WHICH MAY BE DAMAGED BY HEAT, AIR, OR ULTRAVIOLET RAYS. India Patent 92151. Oct. 30, 1965.

A process for the protection of organic materials which may be damaged by heat, air, or uv radiation is described; the process involved the incorporation of a hydroxyaryl-1:3:5-triazine compound. (Indian Sci. Abstr.) (TSS)

33856 ROLE OF NARCOSIS IN THE RADIOPROTECTIVE MECHANISM OF NARCOTIC AGENTS. Strelkov, R. B.; Parasochko, L. A. Radiobiologiya, 7: 459-61(1967). (In Russian).

In experiments on 779 white mice weighing 18 to 22 g, the animals were administered a 1% solution of Barbamil (amobarbital sodium) in doses of 150, 100, and 75 mg/kg. Groups of the experimental animals were gamma-irradiated (^{60}Co, 75 to 58 R/min) with single 900 and 700 R doses. Control animals were administered the standard radioprotectors cystamine (150 mg/kg) and mexamine (75 mg/kg). Some of the experimental animals were also administered caffeine (100 mg/kg) in addition to the Barbamil to determine the radioprotective effect of a narcotic agent without a narcotic state. Survival rate of animals was based on a 30 day period. Experimental data show that with a 900 R dose, Barbamil produced a statistically unreliable effect on animals in a wakeful state as well as in deep narcosis, whereas cystamine and mexamine displayed a marked radioprotective effect. With a 700 R dose, survival rate was 35.7% for animals in a narcotic state and 44.1% for animals in a wakeful state. Reduction of the Barbamil dose to 75 mg/kg decreased the radioprotective effect, but this was not statistically reliable. Findings confirm the authors' assumption that a narcotic state does not play an important role in the radioprotective action of Barbamil. Apparently, nonspecific inhibiting processes in the central nervous system do not participate directly in the radioprotective mechanism. The study demonstrates that a narcotic agent can produce a radioprotective effect without a state of narcosis, but the action mechanism is not clear at this time. (ATD)

33857 AN EFFICIENT TECHNIQUE FOR THE REPRODUCIBLE IN VIVO ASSAY OF THYROIDAL RADIOIODINE IN SMALL ANIMALS. Buddemeyer, E. U. (Johns Hopkins Medical Institutions, Baltimore). Int. J. Appl. Radiat. Isotop., 19: 33-8 (Jan. 1968).

In in vivo thyroid ^{131}I assay with a single detector, unavoidable variation in the position of the animal produces significant error unless the source to detector distance is great. A system is described in which the sacrifice of efficiency for precision is avoided through the use of two opposed detectors that yield highly reproducible count rates despite uncertainty in the exact position of the source. This geometry independence permits precise, automated counting of unanaesthetized and relatively unrestrained rats. Excised organs and standards can also be assayed in the apparatus, allowing accurate determination of isotope uptake. Iso-response curves and data on precision, specificity, sensitivity, and accuracy are given. With appropriate modification, the twin-opposed detector design can be applied to a variety of in vivo counting problems. (auth)

33858 LEUKEMIA IN PATIENTS WITH CANCER OF THE CERVIX UTERI TREATED WITH RADIATION. A REPORT COVERING THE FIRST 5 YEARS OF AN INTERNATIONAL STUDY. Hutchison, George B. (Harvard School of Public Health, Boston). J. Nat. Cancer Inst., 40: 951-82(May 1968).

Patients exposed to radiotherapy for cervical cancer were studied. Patients under observation were seen twice a year during the first five years after diagnosis and annually after the first five years. Peripheral blood studies were made at each visit. An accumulated total of 60,000 person-years was assembled from 29 collaborating radiotherapy centers. Four cases of leukemia were reported in exposed patients, including two myelocytic and two lymphocytic cell types. These numbers and cell types did not differ significantly from expected numbers for a general population of females of the age group studied. A comparison group of cervical cancer patients who did not receive radiotherapy was followed according to the same protocol and accumulated 6,000 person-years, with one case of leukemia observed, of lymphocytic cell type. Leukemia incidences for the total population studied and for various subgroups defined by type of therapy and by interval after radiation exposure were all compatible with general population rates. For patients at risk in the interval four to eight years after exposure, a fivefold increased risk could be excluded, but a fourfold increased risk remained possible. For patients exposed to combined external therapy plus intracavitary radium, observed at all intervals after exposure, a threefold increase was excluded. (auth)

33859 COMBINED SURGICAL AND RADIATION INJURY. THE EFFECT OF TIMING OF WOUNDING AND WHOLE BODY GAMMA IRRADIATION ON 30 DAY MORTALITY AND RATE OF WOUND CONTRACTURE IN THE RODENT. Stromberg, L. W. R.; Woodward, K. T.; Mahin, D. T.; Donati, R. M. (Walter Reed Army Inst. of Research, Washington, D. C.). Ann. Surg., 167: 18-22(Jan. 1968).

The effect of timing of whole-body γ-irradiation and wounding on the mortality and rate of wound contracture was studied. Rats were wounded by excision of a dorsal piece of skin four days before, one day before, one day after and four days after exposure to 875 R. The mortality of non-wounded irradiated animals and animals wounded four days prior to or one day following irradiation was similar. Mortality of animals wounded one day prior to irradiation was diminished, and of those wounded four days following irradiation greatly increased. In animals wounded prior to irradiation there was a minimal transient cessation of wound contracture; in those wounded after irradiation there was an immediate and greater interference with wound contracture, particularly in animals wounded four days following irradiation. (auth)

33860 EFFECT OF MODIFYING AGENTS ON FREE RADICALS OF IRRADIATED ENZYMES IN CONNECTION WITH THEIR RADIATION INACTIVATION. I. EFFECT OF OXYGEN. Aripova, D. F.; Ganassi, E. E.; Kayushin, L. P.; Pulatova, M. K.; Eidus, L. Kh. (Inst. of Biological Physics, Moscow). Biophysics (USSR) (Engl. Transl.), 12: 235-44(1967).

Translated from Biofizika, 12: 206-14(1967).

A study of the effect of oxygen on the electron paramagnetic resonance (e.p.r.) spectrum of free radicals and the enzymatic activity of γ-irradiated pepsin led to the conclusion that neither conversion of the doublet to the singlet signal with intermediate formation of the peroxide radical nor reduction in the number of unpaired electrons influenced latent radiation damage or loss of biological activity. The results indicate that direct transfer of e.p.r. findings to radiobiological damage can lead to errors in results. (C.H.)

33861 ISOTOPIC PLACENTOGRAPHY. Hernady, Tibor; Neubauer, Gyoergy. Magy. Radiol., 20: 95-8(Apr. 1968). (In Hungarian).

The indications for isotopic placentography are reviewed. Red blood cells labeled with chromium-51 proved particularly useful as examination substance, although their advantages if compared with those of the iodide isotope were not of decisive importance. The method and the results of measurement are discussed. (auth)

33862 SOME ROENTGENOLOGIC CHANGES OF THE SKELETON IN DIABETIC PATIENTS. Khadzhidekov, G.; Kukuchev, D.; Rogozhinov, T. Rentgenol. Radiol., 7: 14-19(1968). (In Bulgarian).

Proceeding from a roentgenographic survey in 86 patients with diabetes mellitus the authors describe some skeletal changes. Retarded ossification in patients 2–14 years of age and delayed synostosis during the period 15–20 years of age was frequently observed. Osteoporosis was the most common finding in the roentgenographic examination of diabetic patients. In addition, information is also given on other features observed by the authors associated with the ossification or reconstruction of the bone tissue in diabetic patients (lines of growth, fine cysts in the carpal bones, patchy thickening of the capitulum, pseudoepiphyses, irregularities in the epiphyseal cartillage, gros-reticular structure of the spongiose). About some of these roentgenologic features in diabetes no data are available in the literature. (auth)

33863 EFFECTS OF THE INITIAL RADIODAMAGE ON THE RESTORATIVE POST-IRRADIATION SOAKING OF SEEDS. Atayan, R. R. (Armenian Agricultural Inst., Erevan). Biol. Zh. Arm., 20: No. 9, 42-7(Sept. 1967). (In Russian).

The influence of post-radiative soaking of seeds in oxygen- or nitrogen-saturated water on the cytogenetic damage was studied using γ-irradiated pea seeds. Tabulated data are given on the number of initially injured cells and on cellular restoration during irradiation of dormant pea seeds. (auth)

33864 PROTECTIVE EFFECTS OF THE INDOLYL ACETIC ACID (HETEROAUXIN) AGAINST RADIOINDUCED DAMAGE IN GENETIC CELLS. Araratyan, L. A. Biol. Zh. Arm., 20: No. 9, 48-57(Sept. 1967). (In Russian).

Experiments with Allium fistulosum seeds treated by soaking in solutions of potassium salt of indole-3-acetic acid before a 200 R dose of x-irradiation showed that the heteroauxin exhibited a significant protective effect on the chromosomes. The radioprotective effects were a function of the concentration of the heteroauxin; a solution of 0.01% increased the radioresistance of cells while one of 0.05% activated the restorative cell functions. Results indicated that physiologically active heteroauxin exerted an ordering influence on the chromosomes during the anaphase and reduced the number of lost chromosomes. (C.O.)

33865 CYSTEINE CONTENT IN MOUSE TISSUES AND IN CELLS OF EHRLICH'S ASCITES CARCINOMA AT THE PERIOD OF ITS MAXIMUM RADIOPROTECTIVE ACTIVITY. Tarasenko, A. G.; Tu, Le Suan; Gusareva, E. V.; Graevskii, E. Ya. (Inst. of Development Biology, Moscow). Dokl. Akad. Nauk SSSR, 178: 951-4(Feb. 1, 1968). (In Russian).

It is proposed that the increase in level of thiol groups in a biological substrate in contact with a protective agent is not due to the SH groups introduced by the protective substance, but can be explained by the liberation of endogenous sulfhydryl compounds under its effect. To test this hypothesis mouse carcinoma cells were contacted with ^{35}S-cysteine, separated by centrifugation, and counted on a beta counter. A cell extract treated with sulfosalicylic acid was subjected to paper chromatography at the same time, and the cysteine spot was counted after comparing with a known ^{35}S-cysteine standard. In a similar fashion the amount of cysteine in various mouse tissues was determined quantitatively. It was found that on the average only about 10% of the radioactive ^{35}S was found in the cysteine fraction. Thus indirectly it was proven that cysteine does not provide protection directly against radiation, but exerts an indirect effect. (TTT)

33866 RADIOISOTOPES IN THE DIAGNOSIS AND TREATMENT OF POLYCYTHEMIAS AND LEUKEMIAS. RADIOBIOLOGICAL AND CLINICAL ASPECTS. Torretta, Alessandro (Univ., Turin). Minerva Med., 59: 1361-1404(Mar. 24, 1968). (In Italian).

The complex problems of quantitative evaluation of the radiation dose absorbed in internal radioisotope therapy are discussed and the biological behavior of radioisotopes when introduced into the organism illustrated. The therapeutic effectiveness of radioisotopes depends not only on the chronological and spacial distribution of the dose but also on their electivity of accumulation in normal and neoplastic tissues. The radioisotopes employed for therapeutic purposes in hematology are listed. Internal dosimetry with regard to emittent beta particles of ^{32}P is discussed with reference to the various decay constants (physical, biological, actual) and to the specific integral dose absorbed. After some general clinical remarks on the various types of polyglobulism, real polycythemia is discussed in detail as to etiology, pathological anatomy, symptomatology, and the usefulness of employing certain radioisotopes as tracers in the differential diagnosis between this disease and other types of polyglobulism (such as relative and stress erythrocytosis) and for the study of iron kinetics in patients with polycythaemia. The beneficial action of ^{32}P in the general clinical symptomatology and in the hemotological picture of polycythemia, with early diminution in leucocytes and platelets and later fall in erythrocytes (from the 8th week to the 4th month) is discussed. Administration of ^{32}P by the intravenous way, the most common, requires initial doses between 3 and 7 mCi and even less; total dose must never exceed 15 to 20 mCi. Radioisotope therapy with ^{32}P seems to present indisputed advantages as regards the survival of leukemia patients, especially those suffering from the chronic lymphoid form, over traditional multiple-field x ray therapy and over chemotherapy. In addition to radiophosphorus, colloidal ^{198}Au and ^{206}Bi have been successfully employed in lymphoid leukemia. (auth) (TSS)

33867 STUDY ON CORTISONE PROTECTION OF IRRADIATED SKIN. Orlandini, I.; Azzoni, G. (Istituti Ospedalieri Carlo Poma, Mantova, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 367-9(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The possibilities of prevention and treatment of skin damage by irradiation is outlined. Local application of cortisone proved particularly effective in view of its pronounced antiphlogistic activity. (auth)

33868 HISTOPATHOLOGICAL FINDINGS OF CARCINOMA OF THE NECK OF THE UTERUS, IRRADIATED UNDER HIGH PRESSURE OF O$_2$ (3 ATMOSPHERES).Bini, F.; Peracchia, G. (Univ., Parma, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 470-5(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The accentuated effect of radiation administered at three atmospheres of O$_2$ in four cases of carcinoma of the neck of the uterus is discussed histopathologically. (auth)

33869 PROTECTIVE ACTION OF PLATELET EXTRACTS ON THE HEMOSTATIC DAMAGE DUE TO RADIATION. De Nicola, P.; Luscher, E. F. (Univ., Padua. Univ., Bern). Med. Nucl. Radiobiol. Lat., Suppl. 1, 460-9(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The modifications of blood coagulation, fibrinolysis, and hemostasis after irradiation and treatment with platelet extracts was studied in 153 rabbits and 1146 rats. In the irradiated rabbit the coagulation defect was partly corrected by the administration of extracts containing the platelet factor 3 and to a lesser extent by means of phospholipid extracts of platelets. In irradiated rats there was a reduction of the bleeding time and intensity (method of de Nicola and Candura) and an increase of prothrombin consumption above all with platelet factor 3 and with the phospholipid fraction. By associating the platelet extracts to the parotid inhibitor of fibrinolysis the effects were more marked and there was a reduction in the fibrinolytic activity as well. The survival of animals irradiated and protected with phospholipid platelet extracts was greater than in the irradiated and not protected animals. (auth)

33870 CLINICAL OBSERVATIONS ON TREATMENT WITH AUTOLOGOUS BONE MARROW, PRESERVED AT EXTREMELY LOW TEMPERATURE, IN PATIENTS GIVEN ROENTGENTHERAPY TOGETHER WITH CYTOSTATICS. De Renzi, G. P.; Bartorelli, A.; Vittone, A. (Spedali Riuniti, Livorno, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 450-9(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Results are described of transfusion of autologous bone marrow that was frozen and preserved at extremely low temperature for a long period to patients subjected to intense treatment with cytostatic drugs and radiotherapy. (auth)

33871 FERROKINETICS STUDY IN FUNCTIONAL EVALUATION OF IONISING RADIATION DAMAGE TO BONE MARROW. PROTECTIVE EFFECT OF BONE MARROW TRANSFUSIONS. Bellion, B.; Resegotti, L.; Curino, G.; D'Onofrio, M. (Univ., Turin). Med. Nucl. Radiobiol. Lat., Suppl. 1, 442-9(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Iron metabolism in blood plasma and erythrocyte incorporation of radio-iron in rabbits were studied by comparison of results obtained by exposure to medium and high x-ray doses produced by 200 200 keV roentgentherapy apparatus to those produced by a 31 MeV Betatron. At equal doses, high energy x rays caused more damage to bone marrow. In animals exposed to high doses the protective effect of homologous bone marrow transfusion was examined. The experimental data and the possibility of practical application are discussed. (auth)

33872 SPLEEN HOMOLOGOUS HOMOGENATES EXPERIMENTALLY INJECTED IN RATS TO INHIBIT EFFECTS OF LETHAL DOSES OF PANIRRADIATION AND OF CYCLOPHOSPHAMIDE. Stoppa, I. M. (Univ., Turin). Med. Nucl. Radiobiol. Lat., Suppl. 1, 435-41(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Intraperitoneal injections of spleen homogenates of newborn rats ensured survival of a number of animals treated with ciclophosphamide that had caused death in 100% of injected rats in the control group and likewise in a group panirradiated at a single dose of 800 R. Different methods of treatment were also tried, such as varying the interval between the injection of the drug and that of the spleen homogenate. It was found that injection of 15 × 10^6 spleen cells ensured survival in a considerable percentage of rats treated with lethal doses of cyclophosphamide. This supported the hypothesis that cyclophosphamide in the doses employed caused mortality of the animals with a medullolar inhibition mechanism analogous to that following panirradiation with a single dose of 800 R. (auth)

33873 STUDIES ON THE RADIOPROTECTIVE FACTOR FROM CALVES SPLEEN. De Franciscis, P.; Cifaldi, S.; Comite, F.; Falconi, C.; Scotto, P. (Univ., Naples). Med. Nucl. Radiobiol. Lat., Suppl. 1, 428-34(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Some of the properties, i.e., stability to pH, temperature, and digestion by various enzymes, of a splenic factor that exerted a radioprotective effect on x-irradiated (700 R) mice are described. Procedures used in purification of the splenic factor are also discussed. (auth)

33874 ACTION OF AET ON THE METABOLISM OF HUMAN TUMORAL CELLS IN CULTURE (HeLa). Loni, M. C.; Falconi, C. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Med. Nucl. Radiobiol. Lat., Suppl. 1, 422-7(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The first results obtained in experiments with HeLa cells after treatment with AET are given. The mitotic index and the incorporation of tritiated thymidine in the DNA of the cells were both influenced by AET. A probable mechanism to explain these results is discussed. (auth)

33875 RADIOPROTECTIVE OR RADIOREPARATIVE ACTION OF NUCLEIC ACIDS. Lapenna, M.; Pini, M.; d'Acunzo, L.; Giudici, G. (Univ., Trieste, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 409-21(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Previous studies are outlined on the survival of totally or partially irradiated animals and of those irradiated on cancerous tissues. Heterologous RNA (extracted from calves liver) was shown to have a strong radioprotective action on healthy tissues and on irradiated animals but not on cancer tissues. After a review of the literature on the protective effects of RNA and DNA, results are described of recent studies using homologous RNA (extracted from Ehrlich tumor ascite cells) that was likewise found to be radioprotective to healthy as opposed to cancerous tissues. (auth)

33876 IONIZING RADIATIONS AND CHEMOTHERAPY.. CELL DIFFERENTIATING EFFECTS IN GRAFTED RHABDOMYOSARCOMA. D'Ancona, S.; Fiorentino, M. (Univ., Padua). Med. Nucl. Radiobiol. Lat., Suppl. 1, 395-400(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Experiments were carried out with transplanted dedifferentiated rhabdomyosarcomas that were originally induced in the skeletal muscles of rats by methylcholanthrene. Inoculated animals were given various antiproliferative treatments (whole-body irradiation, localized irradiation and antitumoral drugs including cyclophosphamide, 5-fluorouridine, methylhydrazine, colchicine and testosterone). For each treatment, the maximum tolerated dose, and when possible, the curative dose were established. Research was then focussed on the cytodifferentiating effects of those doses of antitumor agents that proved inhibiting but not curative. Irradiation and cyclophosphamide were shown to be more effective in producing the histological appearance of myoblastic activity in the tumor and their activity was enhanced by combined administration of testosterone. (auth)

33877 AGGIORNAMENTI DI RADIOBIOLOGIA. VOLUME I. VIII CONGRESSO NAZIONALE DELLA ASSOCIAZIONE ITALIANA DI RADIOBIOLOGIA MEDICA, MODENA, 7-9 OTTOBRE 1966. (Updating of Radiobiology. Volume I. 8th National Congress of the Italian Association of Radiobiology). Martinenghi, C.; Canossi, G. C.; Bergonzi, M. (eds.). Med. Nucl. Radiobiol. Lat., Suppl. 1, 1-657(1966). (CONF-661063-(Suppl.1)(Vol.1)).

Separate abstracts were prepared for 45 papers presented at the conference. Various aspects of radiobiological research are included. (B.S.L.)

For abstracts of individual papers see: 33750–33760, 33829, 33830, 33867–33880, and 33939–33957.

33878 EXPERIMENTAL STUDIES OF THE PROBLEM OF INCREASED RADIOSENSITIVITY OF CANCEROUS TISSUES. Barth, G.; Graebner, H.; Romagnoli, U. (Univ., Giessen, Ger. Univ., Pisa, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 485-97(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Albino rats inoculated with Crocker 180 Sarcoma were treated with radiation and parentheral or paratumoral infiltrations of Rutin, Solcoseryl, and nicotinic acid. Results supported the hypothesis that the radiosensitivity of a tumor can be increased by complementary medicinal therapy, the most effective drugs being those that stimulate a greater influx of oxygen in the tumor cells and thereby increasing tumor radiosensitivity. (auth) (TSS)

33879 MUCOPROTEINURIA: A TEST FOR EXPERIMENTAL RADIATION INJURY. ITS IMPORTANCE IN THE ASSESSMENT OF RADIOPROTECTIVE ACTIVITY OF SOME HORMONES. D'Addabbo, A.; Viterbo, F.; Fanfani, G. (Univ., Bari, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 498-505(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Urinary elimination of mucoproteins was studied in rats panirradiated with x rays. After irradiation there was a notable increase in mucoproteinuria; the amount of mucoproteins eliminated correlated with the radiation dose. The amount of mucoproteins inversely correlated with the survival rate of animals exposed to 800 R. In animals administered serotonin or ACTH, mucoprotein excretion and the mortality rate were reduced. Pineal gland extract increased radioresistance and reduced the daily mucoproteins loss. These results suggested that the increased urinary mucoprotein excretion, as an expression of the general and non-specific mesenchyme reaction, could be useful in assessing radiation injury and that mucoproteinuria reflects the radioprotective effect of some hormones on damaged connective tissue. Furthermore, it could be useful in the pathogenetic interpretation of the lesser known radioprotective effects of pineal gland extract. (auth)

33880 COMPARISON OF MORTALITY CURVES OF MICE PANIRRADIATED IN AIR AT 3 ATMOSPHERES OF OXYGEN AND IN HYPERBARIC CHAMBER. Peracchia, G.; Bini, F. (Univ., Parma, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 509-13(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Mortality curves are compared of Swiss mice panirradiated (1000 R dose) in air and in a hyperbaric chamber at 3 atmospheres of oxygen. Comparison showed a 5.21% earlier mortality in animals irradiated in oxygen. (auth)

33881 RADIOPROTECTION OF CHROMOSOMES IN HUMAN MEDULLARY CELLS IN VITRO. NOTE I. PROTECTIVE EFFECTS OF THE INDIRECT ACTION OF CYSTEINE AND THIOCTIC ACID AGAINST IONIZING RADIATION. Cardini, G.; Riggio, G.; Pegoraro, M.; Clemente, R.; Gasparini, C. (Ospedali Riuniti, Vergania, Italy). Radiobiol. Radiater. Fis. Med., 22: 349-54 (Sept.-Oct. 1967). (In Italian).

The effects of radioprotective substances containing sulfhydryl groups (cysteine, thioctic acid) on chromosomes of human medullary cells exposed to 400 R x radiation were studied. Cultures protected by cysteine showed a remarkably lower number of chromosome fragmentations in respect to the controls, and thioctic acid showed a fairly good protective action. (C.H.)

33882 CLINICAL EXPERIMENTATION ON NEW RADIOPROTECTIVE SUBSTANCE, DIMETHYL-METHONINE-SULFONIUM CHLORIDE. De Vecchi, A. (Univ. Milan). Radiobiol. Radiater. Fis. Med., 22: 355-70(Sept.-Oct. 1967). (In Italian).

Results are reported of a clinical test program on a new radioprotective chemical, methyl-methionine-sulfone chloride. Tests were performed by comparing its effectiveness with that of such liver and polyvitamin extracts as are used during the radiotherapeutic treatments with satisfactory results. Methodical appraisals were made of symptoms of radiation sickness induced by x radiation and of erythrocyte and platelet counts, whereupon the findings were statistically processed. The conclusion was drawn that such theoretical and experimental indications as had suggested the drug's valuable radioprotective properties were convincingly substantiated. (C.H.)

33883 INVESTIGATIONS OF SO-CALLED PRIMARY AND SECONDARY JOINT NECROSIS WITH BONE-SEEKING RADIOACTIVE ISOTOPES. Kolar, J. (Charles Univ., Prague); Streda, A.; Bek, V.; Babicky, A.; Bibr, B.; Janko, L.; Kralova, M. Fortschr. Geb. Roentgenstr. Nuklearmed., 108: 487-93(Apr. 1968). (In German).

Experiences in the investigation of 380 joints suspected of undergoing necrotic changes (progressive polyarthritis, idiopathic joint necrosis. Bechterew's disease) are reported. A method is proposed using ^{85}Sr with scanning after twenty-four hours and seven days; normal index values are discussed. A comparison of the two measurements provides better assessment of the pathological changes and their activity than any other method (including radiological examination). The method allows rapid differentiation between active and inactive joint diseases. (auth)

33884 RADIOPROTECTIVE ACTION OF SELENODERIVATIVES: THE EFFECT OF SELENOUREA "IN VIVO". Badiello, R.; Trenta, A.; Mattii, M.; Moretti, S. (Univ., Bologna). Med. Nucl. Radiobiol. Lat., 10: No. 1, 57-68(1967). (In Italian).

A study was made of the radioprotective action of selenourea on rats irradiated with ^{60}Co rays in semi-lethal, lethal, and hyperlethal doses. Irradiations of 600 R, 750 R, and 900 R were carried out on rats in series consisting of three groups: one of control, one protected with cysteine, and one protected with selenourea. Interesting radioprotective effects of selenourea, similar or superior to those of cysteine, were observed from the study of blood modification of the white corpuscles, of mortality, and of general condition. (auth)

33885 POSSIBILITIES FOR ACTUAL LOCATION AND DIAGNOSIS OF TUMORS WITH THE AID OF SCINTILLATION METHODS. Rana, S. A. K.; Dunjic, A.; Demuynck, G. (Univ., Louvain, Belg.). J. Belge Radiol., 50: 373-96(1967). (In French).

The advances in detection and diagnosis of various tumors using radioisotope scanning were reviewed. Techniques and radiopharmaceuticals described were those that were already, or expected to be shortly, in widespread use and were proven of value. Labeled tumor affinity substances were not mentioned as such, as they were still in experimental stages. The organs discussed were the thyroid, brain, lungs, liver, spleen, pancreas, kidneys, bone, stomach and lymph glands. (auth)

33886 INFLUENCE OF THE COMPTON SCATTERING ON THE SCANNING RESOLUTION. Morin, P. P.; Desgrez, A. Ann. Radiol., 11: No. 1-2, R49-66(1968). (In French).

The resolution of scanning pictures is dependent on three factors: detection geometry, statistic fluctuations, and scattering phenomena. The study of the latter was undertaken in both theoretical and experimental fields in the case of the two isotopes ^{125}I and ^{198}Au, whose energies 27 keV and 411 keV produce very different conditions. The theoretical spectral repartition of the scattered photons was studied for these two isotopes, and the possibilities of separation by means of a spectrometer are considered. A series of experiments was carried out. They consisted in studying the modifications of answers provided by a detector which moves across the separation limit between radioactive matter and diffusing matter. The results are given by considering different spectral ranges for each isotope. The following two cases were studied separately. At first, the case of lateral scattering where there are chiefly large angle Compton deviations and which occurs mostly in the case of superficial organs. Then, the case of anterior scattering where there are chiefly small angle Compton deviations and which occurs mostly in the case of deep seated organs. An attempt was made of a theoretical interpretation of the results. (auth)

33887 ENDOLYMPHATIC THERAPY WITH RADIOACTIVE SUBSTANCES (TECHNIQUES AND RADIOMETRY). Weissleder, H.; Pfannenstiel, P.; Strickstrock, K. H.; Hoffmann, G. (Univ., Freiburg i. B.). Fortschr. Geb. Roentgenstr. Nuklearmed., 107: 758-64(Dec. 1967). (In German).

A special pump was developed that substantially simplified the technique of endolymphatic therapy with radioactive substances. The pump was delivered already filled with radioactive material. At the conclusion of the injection, the pump and other instruments contaminated with radioactive materials were returned to the supplier. By this technique the amount of radiation received by the staff was reduced considerably. The radiological and radiometric control of endolymphatic therapy was described. Indications, dosimetry and therapeutic results up to date were discussed briefly. (auth)

33888 PRINCIPLES AND TECHNIQUES OF RENAL SCINTIGRAPHY WITH A ^{99m}Tc IRON COMPLEX. Schmidt, K. J.; Brod, K. H.; Wolf, R.; Haas, J. P. (Johannes-Guentberg-Univ., Mainz). Fortschr. Geb. Roentgenstr. Nuklearmed., 107: 713-27(Dec. 1967). (In German).

The preparation of the ^{99m}Tc-iron complex for renal scintigraphy was described, and the results given for its use in animal experiments and with 150 patients. The advantages of the method were the low radiation doses required, the improved quality of the scintigram and its use for patients with advanced renal insufficiency and iodine sensitivity. (F.M.M.)

33889 EXPECTATIONS AND LIMITATIONS OF LASER PHOTOCOAGULATION. Berler, David K. (Washington Hospital Center, Washington, D. C.). S. Med. J., 60: 1272-6(Dec. 1967).

In all flat retinal tears the laser beam was very effective in creating a satisfactory chorioretinal adhesion. In many cases scleral depression was needed for anterior lesions. Complications were rare. The large number of eyes treated post-operatively may be a deceptive statistic, and merely represents the increased use of cryosurgery for simple tears. Cryopexy via the transconjunctival route is so safe and simple for anterior tears that perhaps some flat tears were so treated, whereas previously the laser would have been used. The ruby laser is within certain limitations, a sophisticated and proven photocoagulator. (auth)

33890 DOSIMETRY SCHEME FOR IRRADIATION OF SUPRAPUBIC SAGITTAL AXIS USING CONVERGING ^{60}Co BEAMS. NOTE I. TECHNICAL STUDY AND IONIZATION MEASUREMENT. Cecchetti, E.; Lentini, A.; Mattii, M.; Cella, C. (Univ., Bologna). Radiobiol. Radiater. Fis. Med., 22: 335-48(Sept.-Oct. 1967). (In Italian).

A technique for use in radiotherapy of neoplasms of the pelvic area is described. Three fields of ^{60}Co γ beams converging on the suprapubic sagittal axis were used for the irradiation of neoplasms in both sexes. Problems of dosimetry are discussed, and isodose curves are presented. (C.H.)

33891 NEW RADIOCOMPOUND WITH POSSIBILITIES IN LYMPHOGRAPHIC STUDIES: RADIOSILVER OLEATE. Anghileri, L. J. (Deutsches Krebsforschungszentrum, Heidelberg); Harbst, H. J. Nucl. Biol. Med., 11: 107-10(July-Sept. 1967).

Silver-110-labeled oleate was developed which presents some advantages over the colloidal radiogold for use in lymphography. Unlike colloidal radiogold, it presents a low uptake by the reticuloendothelial organs and is excreted rapidly through the feces. (auth)

33892 LUNG, LIVER, AND KIDNEY SCANS WITH ^{99m}Tc LABELED DEXTRAN. Johnson, A. E.; Gollan, F. (Veterans Administration Hospital, Miami, Fla. Univ. of Miami, Fla.). J. Nucl. Biol. Med., 11: 103-6(July–Sept. 1967).

Studies showed that it is possible to label carbohydrates like dextran with technetium-99m. Clinical grade dextran with an average molecular weight of 100 to 200,000 was labeled with ^{99m}Tc. Only this labeled dextran, but not the unlabeled dextran, precipitated in cold physiological saline solution with a particle size of 2 micra or less. These labeled particles gave very satisfactory liver scans. Labeled Sephadex particles of 10 to 40 micro in diameter gave homogeneous and clear lung scans. Two hours after injection these particles had been hydrolyzed by the body and excreted by the kidneys, giving at this time satisfactory renal scans. (auth)

33893 AN ASSESSMENT OF THIETHYLPERAZINE (TORECAN) IN THE CONTROL OF RADIATION-INDUCED NAUSEA AND VOMITING. Sicher, K.; Backhouse, T. W. (Coventry and Warwickshire Hospital, Coventry, Eng.). Clin. Radiol., 19: 238-40(Apr. 1968).

A double-blind trial was undertaken to compare thiethylperazine (Torecan) and pyridoxine as anti-emetics in patients undergoing externally applied radiotherapy to the abdomen and pelvis. The patients who received thiethylperazine experienced fewer or much milder symptoms than those given pyridoxine. (auth)

33894 RED CELL SURVIVAL BY ^{51}Cr AND WHOLE BODY COUNTING. Giordani, R.; Giagnoni, P.; Navalesi, R. (Univ. of Pisa, Italy). J. Nucl. Biol. Med., 11: 96-102(July-Sept. 1967).

A method for studying survival of ^{51}Cr-labeled erythrocytes by whole-body counting was developed. The method does not require the measurement of the red cells radioactivity concentration, it may be used under conditions of unsteady state, and can provide information on the production of erythrocytes when combined with the measurement of blood radioactivity. The method was tested in 7 subjects in steady state conditions and the results showed excellent agreement with those simultaneously obtained using the conventional ^{51}Cr technique. (auth)

33895 EFFECT OF RADIOPROTECTIVE AGENTS ON THE DISTRIBUTION OF TRIIODOTHYRONINE ^{131}I. Grigoresco, St., Nedelcou, C.; Nastase, M.; Gheorghe, N. Rev. Roum. Endocrinol., 4: 89-100(1967). (In French).

A study of the effects of some radioprotective agents on the dynamics of the distribution of ^{131}I-triiodothyronine in dogs and rats was made in view of understanding the mechanism of prophylactic radioprotection. The radioprotective agents used (viz., AET, cysteine, adrenalin, and ACTH) inhibited ^{131}I-triiodothyronine uptake. For cysteine, the maximum inhibition of uptake was found one hour after the administration of the radioprotector. The results suggest that the dynamics of ^{131}I-triiodothyronine might be indicative of the level of tissue metabolism. (Romanian Sci. Abstr.)

Radiation Effects on Animals

Refer also to abstracts 33713, 33718, 33724, 33725, 33731, 33742, 33743, 33750, 33756, 33765, 33766, 33772, 33774, 33776, 33778–33780, 33785, 33796, 33797, 33811, 33819, 33821, 33836, 33837, *33842–33845, 33848, 33849, 33851, 33852, 33854, 33858, 33859, 33867, 33869, 33871, 33873, 33881, and 33882.*

33896 (AD–662222) INFLUENCE OF AGE AT EXPOSURE ON SOME PERSISTENT AND LATE EFFECTS OF IRRADIATION WITH FAST NEUTRONS. Jones, David C.; Osborn, Garold K.; Kimeldorf, Donald J. (Naval Radiological Defense Lab., San Francisco, Calif.). Oct. 2, 1967. 32p. (USNRDL-TR–67-121). CFSTI.

In a duration-of-life study, male Sprague-Dawley rats were exposed to 220 rads of fast neutrons as juveniles (1 month of age), young adults (3 months), middle-aged adults (10, 15 months) or as old adults (21 months) and compared with their sham-irradiated littermates at intervals, using a variety of criteria of radiation injury. In all five age groups, there was a deficit in body weight that persisted throughout life. The magnitude of this deficit was inversely related to age at exposure. Decreased food and water consumption were seen throughout life in the group irradiated as juveniles, and were less affected after exposure at older ages. These consummatory changes appeared related to the changes in body size. An age-associated marked increase in water consumption per unit metabolic size occurred earlier (than in controls) in animals exposed as juveniles or as young adults, but not in the groups exposed at older ages. Proportions of exposed groups with one or more palpable growths were in excess of the proportion for the appropriate controls after exposure at all except the oldest age, in spite of significant life-shortening after exposure at all except the oldest age, in spite of significant life-shortening after exposure at the three younger ages. Proportions of irradiated groups with palpable growths of large size (2.5 cm or more) exceeded those for controls even for the group exposed at 21 months. Thus, for criteria of metabolic injury and of the chronologic advancement of degenerative and neoplastic changes, it appears that exposure at a juvenile age is most effective for most criteria, but that some late effects of irradiation are discernible even after exposure during old age. (TAB)

33897 (BNL–12348) VASCULO-CIRCULATORY FACTOR IN THE CENTRAL NERVOUS SYSTEM PATHOGENESIS OF THE X-RAY POSTIRRADIATION EFFECTS. Roizin, L.; Carsten, A. L.; Machek, J.; Liu, J. C.; Caveness, W. F. (Brookhaven National Lab., Upton, N. Y.). Mar. 22, 1968. Contract AT(30-1)-3014. 6p. (CONF-680602–1). Dep. CFSTI.

For presentation at Annual Meeting of the American Association of Neuropathologists, Washington, D. C.

The effects of x radiation on the central nervous system of monkeys were studied. Animals were infused with Evans blue-labeled albumin and fluorescein isothiocyanate-labeled gamma globulin and sections of the brain were made. Descriptions of macroscopic and microscopic appearances of the brain are given. It was concluded that the character, severity, and evolution of the induced bio-physico-chemical and structural lesions depended upon the experimental conditions related to the type, frequency, and dose of radiation, the biological characteristics of the experimental model, and the duration of the experimental investigations. (H.L.W.)

33898 (COO–1421-3) GAMMA IRRADIATION EFFECTS ON TOXIC RESPONSES OF FISH. Progress Report. Neuhold, John M. (Utah State Univ., Logan. Dept. of Wildlife Resources). June 28, 1967. Contract AT(11-1)-1421. 69p. Dep. CFSTI.

OSTEICHTHYES—Salmo gairdneri, radiation effects on survival of, effects of sodium halides on γ
RADIATION DOSE—use of Randomized Split Plot design for determining lethal, for fish
MORTALITY—analysis of variance of, in γ-irradiated rainbow trout (H.L.W.)

33899 (EUR–3906) STUDIO DEL MECCANISMO D'AZIONE DELLE RADIAZIONI IONIZZANTI ED ULTRAVIOLETTE NELLE CELLULE DI MAMMIFERO IN COLTURE IN VITRO. RELAZIONE ANNUALE 1.11.1965–31.10.1966. (Study of the Action Mechanism of Ionizing and Ultraviolet Radiations In Vitro Cultures of Mammalian Cells. Annual Report, November 1, 1965–October 30, 1966). (Rome Univ. (Italy). Istituto di Genetica). Mar. 1968. Contract 036-64-6 BIOI. 20p. (In Italian). Dep.

During the research group's second year of work on the combined effects of x rays and ultraviolet radiation on in vitro cultures of mammal cells, experimental activity was principally devoted to furthering the following investigations: relations between exposure doses and cell survival at various wavelengths, extending the investigation to wavelengths of 2520 Å and 3010 Å; relative efficiency of the four wavelengths under study, with equal exposure doses, in producing changes in the duration of the various phases of the cell cycle; relative efficiency of the same four wavelengths, with equal exposure doses, in inducing chromosomal aberrations observed during the various phases of the cell cycle; and relations of dose to effect with a given wavelength (2650 Å) in terms of induced aberrations observed during a whole cell cycle. Also, as part of the study of uv radiation effects on mammal cells, the experiments were continued on the action of 8-methoxypsoralene activated by uv light (3650 Å), with, particular reference to the effects in inducing chromosomal aberrations in various cell strains (Chinese hamster and human amnion), and the relations between irradiated cell-cycle phases and sensitivity to the induction of chromosomal aberrations. (auth)

33900 (JPRS–41315) EFFECT AND USE OF ULTRAVIOLET RADIATION. Translated from pp 3-14; 122-30; 203-11; 317-26 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966. 55p. (TT–67-31955). CFSTI. JCL $5.60 fs, $1.85 mf.

Separate abstracts were prepared for five chapters of the book. (H.L.W.)

For abstracts of individual chapters see: 33710, 33837, 33901, 33984, and 33996.

33901 (JPRS–41315, pp 16-25) PHYSIOLOGICAL EFFECT OF ULTRAVIOLET RADIATION. Rosin, Ya. A.; Frank, G. M. Translated from pp 122-30 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966.

A review is presented of the effects of ultraviolet radiation on various systems of the animal body. The production of erythema of the skin and development of subsequent reactions are emphasized. A discussion is presented of the formation of vitamin D in the skin of various animals. Effects of ultraviolet radiation on the functioning of the gastrointestinal tract, the heart, pancreas, and other organs of the animal body are reviewed. Changes in albumin, globulin, and sugars of the blood induced by ultraviolet radiation are reviewed. (H.L.W.)

33902 (ORO-3343-1, Paper 3) RBE OF π^--BEAMS IN THE BRAGG-PEAK REGION USING POLYPLOIDY INDUCTION IN MAMMALIAN CELLS IRRADIATED IN VIVO. Loughman, W. D. Feola, J. M.; Raju, M. R.; Winchell, H. S. 25p.

RELATIVE BIOLOGICAL EFFECTIVENESS—comparison of electrons, gamma radiation, and mesons(π^-) for effects on ploidy of ascites lymphoma cells of mice
MESONS(π^-)—effects on ploidy of ascites lymphoma cells in mice, RBE for (H.L.W.)

33903 (ORO–3343-1, Paper 4) EFFECT OF NEGATIVE PIONS ON THE PROLIFERATIVE CAPACITY OF ASCITES TUMOR CELLS (LYMPHOMA) IN VIVO. Feola, J. M.; Richman, C.; Raju, M. H.; Curtis, S. B.; Lawrence, J. H. 15p.

An attempt to determine the RBE of negative pions at peak as compared to plateau and to gamma rays was made. LAF_1 mice bearing 5-day old ascites tumors were irradiated at the two regions of the 90 MeV pion beam for 40 hours in temperature and humidity-controlled holders. At the end of the irradiation, the animals were sacrificed, lymphoma cells withdrawn and titrated into adult female LAF_1 recipient mice. Proliferative capacity was evaluated at the end of eight weeks by the percentage of animals developing ascites tumors. Surviving fractions were then calculated from TD_{50}'s of control and irradiated animals. Radiation doses were measured with calibrated LiF dosimeters in the plateau region. Peak doses were calculated from those at the plateau, using a measured average peak-to-plateau ionization ratio of 1.5. The total doses at plateau ranged from 145 to 250 rads, the doses at peak ranged from 220 to 380 rads. The survival curve for the cells irradiated in the peak gave a D_0 = 65 ± 15 rads. The plateau points were inconsistent. A replication experiment was done using ^{60}Co γ-rays; and D_0 = 350 ± 50 rads was found. If γ-rays are taken as baseline, an RBE of 5.4 ± 1.8 is obtained for the negative pions at peak. (auth)

33904 (ORO–3343-1) THE DOSIMETRY AND RADIOBIOLOGY OF NEGATIVE PIONS. Summary Report, June 1967. Richman, Chaim (Southwest Center for Advanced Studies, Dallas, Tex.). Contracts AT(40-1)-3343; N00014-67-A-0310-0002. 107p. Dep. CFSTI.

Three separate abstracts were prepared on the reports in this summary. One other abstract appears in NSA (20: 18190). The summary presents a general description of pion beams and their application in radiotherapy and in radiobiological systems. (E.R.B.)

For abstracts of individual papers see: 33902, 33903, and 33905.

33905 (ORO-3343-1, Paper 5) FUTURE PROGRAMS ON ANALYSIS, DOSIMETRY, AND RADIOBIOLOGY OF π^--BEAMS. 17p.

MESONS (π^-)—production for radiobiology research, use of synchrocyclotrons for; dosimetry; use of ionization chamber for; pulse distribution in mice; effects on Ascites tumor cells, RBE for; effects in neoplasms, therapeutic. (E.R.B.)

33906 (UCLA-34-P-132-S1) FINAL REPORT [ON BRAIN LESIONS FROM IONIZING PARTICLE IRRADIATION]. (California Univ., Los Angeles). 1968. Contract AT(11-1)-34. 2p. Dep. CFSTI.

BRAIN—radiation effects on axons, cortical thickness, fiber growth, zonal lamina, and glial cells in cerebrum of, of monkeys and rats, α

DISEASES, PHYSIOLOGICAL—necrosis, radioinduced, in cerebral cortex of monkeys and rats, α

33907 (UR-49-913) RADIATION TIME-INTENSITY AND PATHOPHYSIOLOGIC CORRELATIONS IN WHOLE AND PARTIAL-BODY X-IRRADIATED BEAGLES. Michaelson, Sol M.; Woodward, Kent T.; Odland, Lawrence T.; Howland, Joe W. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). Mar. 1, 1968. Contract W-7405-eng-49. 26p. (CONF-680410-2). Dep. CFSTI.

From Symposium on Dose Rate in Mammalian Radiation Biology, Oak Ridge, Tenn.

Two series of beagles were exposed to 1000 kVp x rays. The first series consisted of animals given whole-body irradiation dorso-ventrally in a single session of 450 R, 600 R, or 700 R at 1 R/min, and 400 R or 600 R at 11.4 to 12.2 R/min. In the second series, beagles were exposed bilaterally to 150 R to 400 R whole-body, 700 R to 1100 R lower-body, or 970 R to 2425 R upper-body, in single sessions or by fractionation at 12, 24 or 48 hr intervals at 50 to 65 R/min or 8 to 12 R/min. All were Midline Air Exposure Doses (MAED). Sham-irradiated animals were included for comparison. The estimated median lethal midline air exposure dose for the dorso-ventrally irradiated dogs was 657 R ± 30 R (S.D.) at 1 R/min and 502 R ± 22 R at 11.4 to 12.2 R/min. Shielding influenced lethality in relation to location of radiosensitive body organs and systems. The 60 day median lethal dose for bilateral irradiation (50 to 65 R/min) was 308 R ± 18 R, 878 R ± 9 R, and 1998 R ± 48 R for whole-body, lower-body, and upper-body irradiation respectively. In addition to intensity of irradiation, the interval between exposures, i.e., 12, 24, or 48 hours, was an important determinant of lethality. The influence of total dose, dose-rate or the interval between exposures was also reflected by changes in hematologic indexes. The higher rate of dorso-ventral irradiation was consistently more effective in depressing various white cell components. Some fractionation schedules were more effective than single exposures when selected portions of the body were irradiated suggesting that cyclic variations in metabolic activity of specific cell types influence the synergism, augmentation, or reduction of the response in relation to the interval between exposures. (auth)

33908 RADIATION RESEARCH IN TRANSPLANT SURGERY AND OTHER MEDICAL WORK. Int. At. Energy Agency Bull., 10: No. 2, 16-18(1968).

Some of the ways in which radiation can be used in immunology and replacement surgery are succinctly discussed. Radiation effects on hematopoiesis, immune response of the body, and incidence of leukemia in man are included. IAEA research in progress on use of radiation for sterilization of organs for transplantation, radiotherapy of leukemia and some kinds of cancer, and the application of bone marrow transplants in persons involved in radiation accidents are also very briefly discussed. (B.S.L.)

33909 CIRCADIAN ACTIVITY OF THE DEER MOUSE, PEROMYSCUS: EFFECT OF DEUTERIUM OXIDE. Suter, Robert B.; Rawson, Kenneth S. (Swarthmore Coll., Pa.). Science, 160: 1011-14(May 31, 1968).

Chemical modification of a vertebrate activity rhythm, the circadian (approximately 24-hour) rhythm of Peromyscus leucopus novebroacensis, was demonstrated. Activity in a running wheel was used to measure the rhythms of mice kept individually in conditions of continuous darkness. Deuterium oxide was presented in the drinking water. The length of the periods of rhythm increased directly and linearly with the increase in concentration of deuterium oxide. There is no threshold for this effect, and the maximum concentration of deuterium oxide (30 percent) that was presented resulted in a 6 percent lengthening of the period of circadian rhythm. The mice reverted to rhythms similar in period length to control values after deuterium oxide was withdrawn from their drinking water. (auth)

33910 EFFECT OF X IRRADIATION ON MASTOCYTOMAS IN DOGS. Slusher, R. (Univ. of Illinois, Urbana); Roenigk, W. J.; Wilson, G. P. J. Amer. Vet. Med. Ass., 151: 1049-54 (Oct. 15, 1967).

Histologic effects of conventional x irradiation on mast cell tumors in 18 dogs were studied. The doses varied from 300 to 3000 R administered over an 18-day period either in fractionated doses or single doses of up to 3000 R. After a single dose of 2000 R the skin healed in five to six weeks with no complications. Single exposures up to 3000 R applied to the abdominal area of dogs did not produce radiodermatitis. There were no appreciable differences in a total dose effect of 3000 R applied in a single exposure or in three fractional doses given seven days apart. A single exposure of 2000 R applied to the scrotum did not produce complications. Microscopic examination was performed prior to x irradiation of the tumor and at varying time intervals after treatment to ascertain effectiveness of treatment. Inadequate field size resulted in marginal recurrences in three dogs, and fractionation in high doses caused necrosis. Necropsy was performed on nine dogs. Fractionation, with a total dose of 700 to 3000 R administered during a period of 7 to 14 days was found to be a curative dose. Marginal recurrences required special consideration in selection of field size to decrease recurrence. Further studies are essential to establish a minimum time-dose schedule for canine mastocytoma. (BBB)

33911 CHANGES OF THE RESPIRATORY CENTER IN RABBITS WITH ACUTE RADIATION SICKNESS, COMPLICATED BY BLOOD LOSS. Mailyan, E. S. (Inst. of Roentgen-Radiology and Oncology, Erevan). Zh. Eksp. Klin. Med., 7: No. 4, 17-22 (1967). (In Russian).

In experiments on rabbits it was established that during acute radiation sickness (800 R), complicated by blood loss, the excitability of the respiratory center in the majority of cases was reduced. Acute radiation sickness combined with blood loss was more serious than radiation sickness alone. (tr-auth)

33912 COURSE OF ANAPHYLACTIC SHOCK IN ANIMALS AT DIFFERENT TIMES AFTER INTRODUCTION OF ^{210}Po. Ulanova, A. M.; Zueva, V. A. Radiobiologiya, 7: 425-8(1967). (In Russian).

Guinea pigs injected intraperitoneally with 5 μCi of ^{210}Po/kg were sensitized 3, 15, or 30 days or 1 or 2 yrs. later by an injection of 0.2 ml of equine serum. An injection releasing the anaphylactic reaction was made 13 days after the primary sensitization. Except on the 30th day, the anaphylactic shock in animals injected with ^{210}Po was more frequent and pronounced and resulted in a higher percentage of deaths than in control animals. The effect of ^{210}Po in intensifying anaphylactic shock was greatest on the 15th day after administration. Two years after administration of ^{210}Po the surviving animals (40% of the animals died 3 to 4 months after the injection of ^{210}Po) exhibited a much more severe anaphylactic reaction than control animals. The lethality from anaphylactic shock was 15 to 20% at that time as compared with zero for control animals. (auth)

33913 EARLY CHANGES IN PERITONEAL LEUKOCYTES OF WHOLE-BODY X-IRRADIATED RATS. Harris, J. W.; Noonan, T. R. (Univ. of Rochester, N. Y.). Int. J. Radiat. Biol., 13: 183-5(1967).

The response of peritoneal leukocytes in rats was followed during the first 24 hr after x irradiation. Whole-body exposures were performed. All animals were maintained on a normal diet and tap water before, and on water only after irradiation or sham irradiation. Control animals were rotated in an identical lucite wheel shielded by lead. At various intervals after exposure, rats were bled to death by cardiac puncture, a sample of undiluted peritoneal fluid was collected, and the cavity was then rinsed with 5 ml of ice-cold saline containing heparin. The fluid thus obtained was centrifuged, the cells resuspended in rat serum, smeared on cover-slips, and stained with Wright's stain. Leukocyte counts were then made. The concentration of cells in undiluted peritoneal fluid was measured in 5 to 11 irradiated rats per time interval and in 27 control rats. Total peritoneal leukocyte content was computed by multiplying the cell concentration of each individual fluid by its volume. There was no significant change in peritoneal leukocyte count during the first eight hours, but 24 hr after irradiation the count was 65 to 70% of normal. Results indicate that peritoneal cell counts declined more slowly after whole-body irradiation than blood leukocyte counts. (C.H.)

33914 RESULTS OBTAINED IN A MICROBIOLOGICAL EXAMINATION OF THE MEAT OF PIGS KILLED BECAUSE OF IRRADIATION SICKNESS. Pawel, Otto; Kalousova, Vilma; Vranovska, Jirina. Vet. Med. (Prague), 12: 361-6(July 1967). (In Czech).

In experiments carried out with 67 animals the development of bacteremia in the case of acute irradiation sickness was investigated in swine. In the animals killed at the three main periods of the development of acute irradiation sickness the lymphatic nodes and the muscles were examined. Microbiological examination produced the following results: A penetration of germs outside the intestinal tract occurs already in the period of the disease in which the manifest clinical symptoms of acute irradiation sickness are not yet developed. Germs are found first of all in the organs, i.e., particularly in the livers and in the spleens. Among the germs found in irradiated animals we diagnosed no representatives of the principal infectious diseases of pigs caused by bacteria. The majority of the microorganisms found consisted of coliform germs and streptococci. (auth)

33915 SPACE BIOMAGNETICS. Busby, Douglas E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Space Life Sci., 1: 23-63(Mar. 1968).

Astronauts who venture from their spacecraft onto the lunar surface and the surfaces of our neighboring planets will be exposed for a few hours in duration to magnetic-field intensities which are markedly less than that of the earth's field. The intensities of magnetic fields to which they will be exposed while inside their spacecraft can be stated only after completing a detailed survey of the contribution made to these fields by the functioning electronic components of spacecraft. Assessment of individuals regularly working in and exposed continuously for 10 days to magnetic fields less than 100 gammas in intensity indicate that extremely low-intensity magnetic fields encountered during a nominal Apollo moon mission should not affect astronaut health or performance. Careful physiological and psychological observations first on higher primates, then on man exposed to such fields for more prolonged periods of time must be carried out before this conclusion can be drawn for longer exposures. Recent technological advances in propulsion and radiation protection have made it possible that astronauts might also be exposed intermittently to high-intensity, relatively low-gradient magnetic fields during space missions. The duration of such exposures could range from less than an hour if an activated magnetohydrodynamic engine must be serviced, to several days if pure magnetic or plasma-radiation shielding is used for astronaut protection from solar flare radiation. From past experience with personnel who enter high-intensity magnetic fields for brief periods of time in their work, magnetic-field exposures while servicing magnetohydrodynamic engines should not be hazardous to astronauts. On the other hand, past exposures of man and sub-human systems to high-intensity magnetic fields do not indicate whether or not astronauts who are exposed for up to several days to currently estimated magnetic-field intensities associated with pure magnetic or plasma-radiation shielding could suffer impairment of their health or performance. This answer can be obtained only by carefully conducted experiments that closely simulate such exposures, and look closely for physiological, psychological and pathological changes, especially in exposed higher primates, before assessing the response of man to such exposures. (auth)

33916 LIFE IN SPACE. Libby, W. F. (Univ. of California, Los Angeles). Space Life Sci., 1: 5-9(Mar. 1968).

The physical conditions of space that are most inhospitable to man are discussed. In the discussion on radiation safety emphasis is placed on the dose and the measures that would be necessary for protection or shielding of man against solar radiations. The extraterrestrial occurrence of lower forms of life is also discussed. (B.S.L.)

33917 GERM CELL CHIMERISM: ABSENCE IN PARABIOTIC FROGS. Volpe, E. Peter; Curtis, Sherill (Tulane Univ., New Orleans). Science, 160: 328-9(Apr. 19, 1968).

Embryos of the leopard frog deprived of primordial germ cells by treatment with ultraviolet light were joined in parabiosis with normal, unirradiated embryos. The irradiated member of the pair was not colonized by germ cells from its normal partner. Unlike the primordial germ cells of birds and mammals, the germ cells of frog embryos are not carried by the circulating blood. (auth)

33918 HEMATOLOGICAL RECOVERY OF MOUSE FOLLOWING FETAL X-RADIATION. Rugh, Roberts; Somogyi, Csilla (Columbia Univ., New York). Contract AT(30-1)-2740. Biol. Bull., 134: 320-4(Apr. 1968).

Irradiation of 15-day mouse fetuses with graded doses of x-rays was carried out, and the responses of blood elements two days later at gestation age 17 days were determined. In the fetus at 17 days, two days following x-irradiation in utero (at 15 days), there were increments in the white cell counts that correlated with the level of exposure (50 R and 100 R). This was in contrast to the expected reaction of adult mice of the same strain. At 17 days the erythrocyte counts showed a significant depression following 100 R exposure at 15 days' gestation. This too was in contrast with the adult reaction. All platelet counts of those mice irradiated 15 days and examined at 17 days' gestation were depressed below the control levels, but by three weeks post-natal development they were within the normal range. Both red and white blood cell counts of fetally irradiated mice returned to normal by three weeks after birth. Exposure of the 15-day fetus resulted in a defensive reaction expressed in temporary leukocytosis, as opposed to the normal leukopenia of adult mice similarly exposed, but by three weeks of post-natal age both the differential and all other cell counts were within the normal range. This meant that effects on the fetal blood (hematopoiesis) were temporary, since there was no evidence of any mortality at the levels of radiation used nor of any permanent effects on the blood counts. (B.S.L.)

33919 DESOXYRIBONUCLEASE ACTIVITY OF URINE IN AMINALS IRRADIATED BY FAST NEUTRONS. Chebotar'ov, E. Yu.; Ryabova, E. Z. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 258-61(Mar.-Apr. 1968). (In Ukrainian).

White rats weighing 130 to 140 g were irradiated with fast neutrons at a dose of 215 RAD and the activity of deoxyribonucleases (DNAase) in the urine was determined. The purpose of the study was to determine whether or not DNAase activity of the urine could be used to determine the extent of radiation injury. The results also offer additional data on the mechanisms of chemical exchange of nucleic acid under conditions of irradiation. (R.V.J.)

33920 REGULARITIES OF TRANSITIONAL PROCESSES CHARACTERIZED BY TEMPERATURE CHANGES IN THE RAT BODIES SUBJECTED TO THE X RAY RADIATION. Tkach, V. K.; Boiko, V. I. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 117-20(Jan.-Feb. 1968). (In Ukrainian).

X irradiation of rabbits at doses of 100 to 300 R produced transition processes that were expressed by variations in rectal temperature. The intensity and the leveling off of the processes depended on the dose. (R.V.J.)

33921 LIPID CHANGES IN VARIOUS RAT ORGANS AFTER WHOLE-BODY IRRADIATION WITH LETHAL X-RAY DOSES. VII. THE BEHAVIOR OF FATTY ACID COMPOSITION IN THE KIDNEYS AND CARDIAC MUSCLES. Eberhagen, Dietrich; Horn, Ursula (Univ., Munich). Strahlentherapie, 135: 464-6(Apr. (1968). (In German).

The amount of total lipids and fatty acids was determined in the kidney and cardiac muscle of rats at different intervals following whole-body irradiation. The composition of the fatty acids was determined by gas chromatography and only small variations were found after irradiation. It was suggested that this was due to the radioresistance of these organs. (auth)

33922 EFFECT OF WHOLE-BODY GAMMA-IRRADIATION ON THE NITROGEN EXCRETION IN RAT LARGE INTESTINE. Logar, Alvina; Kregar, Igor; Lebez, Drago (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Strahlentherapie, 135: 486-88 (Apr. 1968).

Excretion of nitrogen compounds was followed from the partly isolated colon of normal and whole-body irradiated rats. No changes after 600 R were observed; an increase in excreted nonprotein nitrogen was noted 3 hrs after irradiation at 1200 R. It was assumed that the irradiation caused increased catabolic processes in the rat colon. (auth)

33923 INFLUENCE OF A MIXTURE OF CHEMICAL PROTECTORS ON THE LYMPHOPOIETIC AND HEMATOPOIETIC SYSTEM OF MICE IRRADIATED WITH A DOSE OF 2000 R OF X-RAYS. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Experientia, 24: 230-1(Mar. 15, 1968).

The bone marrow, spleen, and thymus show, 30 days after a dose of 2000 R of x rays and pretreatment with AET + glutathione + 5-HT + cysteine, an almost normal histologic and cytologic picture At the same time, regeneration in the lymph nodes and the Peyer's patches has set in, but is less advanced. (auth)

33924 INFLUENCE OF PRENATAL X-RADIATION ON BRAIN LIPID AND CEREBROSIDE CONTENT IN DEVELOPING RATS. Vernadakis, Antonia; Casper, Regina; Timiras, Paola S. (Univ. of California, Berkeley). Contract AT(11-1)-34. Experientia, 24: 237-8(Mar. 1968).

When rats were x-irradiated on the fourteenth day of gestation the content of cerebrosides in the cerebral cortex and in the diencephalon was higher than that of controls. The treatment resulted in a proliferation of glial cells and an augmentation of the sensitivity of the central nervous system to electrical stimulation. The possibility of a relationship between these phenomena is discussed. (tr-auth)

33925 WEIGHT CHANGES AFTER WHOLE BODY GAMMA RAY IRRADIATION IN THE SUBMAXILLARY GLAND OF UNPROTECTED AND CYSTAMINE-PROTECTED RATS AND AN ATTEMPT AT THEIR QUANTITATIVE INTERPRETATION. Vodicka, I.; Petyrek, P. (Purkyne Military Inst. of Medical Research and Postgraduate Study, Koeniggraetz, Czech.). Folia Biol. (Prague), 14: 148-55(1968).

After whole-body γ irradiation the relative weight of the submaxillary glands of unprotected female rats and animals protected with cystamine fell exponentially with mounting doses on the fourth day after irradiation. The drop in protected rats was significantly smaller, however. Histological changes in the salivary glands on the fourth day after irradiation with 500 and 750

R were not very marked (hyperemia, isolated microhaemorrhages), while after a dose of 1,000 R they were pronounced (an increase in the number of cells with secretion granules, pathological changes in the nuclei of secretory cells). By the seventh day after irradiation with 700 R, the relative weight of the salivary glands in both groups returned to normal and by the 15th day it fell again. The wet and dry weight of the glands was affected equally by these weight changes. The possibility of utilizing these changes for the quantitative evaluation of the protective effect of radioprotective substances or of the degree of radiation injury is discussed. (auth)

33926 STIMULATING AND DEPRESSIVE EFFECT OF X RAYS ON THE FUNCTIONAL STATE OF THE RETINA AND ON ITS ABILITY TO INDUCE CORNEA FORMATION. **Popov, V. V.; Ul'yanova, V. V. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 177: 728-31(Nov. 21, 1967). (In Russian).**

Well-developed frog tadpoles with two back extremites were subjected to whole-body x ray doses of 10, 20, 30, 40, 50, 100, 200, 300, 400, 500, 600, 700, 800, 1000, and 1500 R. Normal skin from the back of an unirradiated donor was grafted onto the outer cornea of the right eye of the irradiated host. In the controls the first signs of clearing up of the eye were noted on the 9th day, as expressed by a slight dimunition of chromatophores. A small section devoid of pigmented cells appeared on the 14th day, and on the 20 to 25th day, no more new cornea formed. With a dose of 10 to 50 R, the first signs of clearing up of the skin transplant were noted on the 6th day after the operation, and corneal induction was finished by the 14th day. With a dose of 100 R the irradiated retina did not differ from normal, but a dose of 200 to 600 R led to a loss of corneal induction. The first depigmentation in these cases was observed on the 11th to 18th day after irradiation. A dose of 700 R to the retina led to a complete loss of corneal induction in the grafted skin. Each photoreceptor cell is supplied with a single ellipsoid consisting of the number of mitochrondria. The relative size of this ellipsoid was found to be 1.73 for a normal cell, and 1.12 for a cell given a dose of about 700 R. (TTT)

33927 FACTORS INFLUENCING GROWTH OF PARENTAL MARROW GRAFTS IN IRRADIATED F_1 HYBRID MICE. **Goodman, Joan Wright; Wheeler, H. Brownell (Oak Ridge National Lab., Tenn. Harvard Medical School, Boston. Veterans Administration Hospital, West Roxbury, Mass.). Transplantation, 6: 173-86(Mar. 1968).**

Transplantation of morphologically intact spleen slice grafts from parental to F_1 hybrid mice prior to lethal x irradiation markedly improved the growth of subsequent parental marrow grafts. Stromal elements were not responsible for the improved marrow growth, inasmuch as similar results were obtained when F_1 hybrid was pretreated with parental spleen cell suspensions or spleen slice grafts which were removed before irradiation. Further exploration of these findings showed that pretreatment of hybrids must be carried out with immunologically competent cells; these cells must be viable; time is required for full development of the pretreatment effect, 2 to 3 weeks being optimal for 3×10^7 spleen cells; the effect is long lasting (at least 3 months); pretreatment with as few as 10^6 parental spleen cells can lead to a significant modification of the poor growth phenomenon. Augmentation of marrow growth was observed in every experimental setting where a graft-versus-host reaction due to cells from the marrow donor strain had occurred prior to irradiation. Relatively good growth of parental marrow grafts was observed in reirradiated old chimeras when either chimeric donor or host was of the parental type. (auth)

33928 THYMUS DEPENDENCE OF ADOPTIVE IMMUNITY IN IRRADIATED MICE. **Doria, Gino; Agarossi, Giovanna (CNEN-EURATOM, Rome). Transplantation, 6: 218-29(Mar. 1968).**

Thymus dependence of adoptive immunity by transplanted bone marrow or spleen cells was quantitatively assessed by measuring their agglutinin response in thymectomized and nonthymectomized x irradiated mice. In all experimental conditions used, spleen cells were found remarkably less sensitive to thymectomy than bone marrow cells. The degree of thymus dependence of spleen cells varied with the donor age. The data suggest the existence of two pools of potentially competent cells: PC_0 (thymus-dependent) and PC_1 (thymus-independent) cells, the former being relatively more frequent in the marrow than in the spleen. Variation of thymus dependence with age is attributed to changes of the relative pool size of PC_0 and PC_1 cells. (auth)

33929 DYNAMICS OF DISAPPEARANCE OF SOME TYPES OF CHROMOSOME ABERRATIONS FROM EPITHELIAL CELLS OF THE CORNEA OF IRRADIATED MICE. **Mastryukova, V. M.; Strzhizhovskii, A. D.; Galaktionova, G. V. (Inst. of Biomedical Problems, Moscow). Tsitologiya, 10: 464-70(Apr. 1968). (In Russian).**

A study was made of the duration of mitotic cycles as well as of the development and dynamics of disappearance of chromosome aberrations in the corneal epithelial cells of mice exposed to γ irradiation and 630 MeV protons. It was shown that bridges, fragments, and some more heavy injuries (mixtures of bridges and fragments) remained in tissues for 2.26 to 3.20, 1.65 to 2.10 and 1.66 to 1.89 cellular cycles, resp. The average time of the existence of aberrations did not depend on the radiation dose within the dose range from 200 to 700 rad. This shows no significant changes after replacement of γ irradiations with the similar doses of proton irradiations. (auth)

33930 INTERACTION OF IONIZING RADIATION AND E. COLI ENDOTOXIN. I. EFFECT OF RADIATION ON ENDOTOXIN SHOCK. **Vick, James A. (Medical Research Lab., Edgewood Arsenal, Md.); DeGraaf, Richard; Berdjis, Charles C. Mil. Med., 133: 387-90(May 1968).**

Escherichia coli endotoxin produces a variety of physiological changes when injected intravenously into the dog. These changes appear to be initiated by the release of histamine or a histamine-like substance into the blood stream from disrupted platelets and mast cells. This is thought to follow an interaction between the endotoxin and a heat-labile serum factor. The fact that irradiation also affects the hematopoietic system has presented the possibility that the effects of *E. coli* endotoxin and irradiation may interact. This possibility was investigated in 38 adult mongrel dogs divided at random into four groups. Six animals were x-irradiated (1000 R); six animals were injected with 1.0 mg/kg of *E. coli* endotoxin; 12 animals were injected with 1.0 mg/kg of *E. coli* endotoxin 30 minutes after x irradiation (1000 R); and 14 animals were injected with 1.0 mg/kg of *E. coli* endotoxin two hours after x irradiation (1000 R). Arterial blood pressure was continuously monitored and recorded. Respiratory rate, electrocardiogram (EKG), and heart rate were also recorded. The survival data for the four groups of animals showed that irradiation two hours before endotoxin prolonged the time of death and irradiation 30 min before endotoxin delayed the lethal action of endotoxin markedly, while one animal survived. A less precipitous fall in blood pressure was observed. It was concluded that irradiation suppressed the development of endotoxin shock and significantly changed the course of the shock syndrome. (C.H.)

33931 ULTRAVIOLET FLUORESCENCE OF ALIVE AND DEAD CELLS OF BLOOD AND BONE MARROW IN IRRADIATED ANIMALS. **Safronova, V. G.; Yagunov, A. S. (Central Research Roentgen-Radiological Inst., Leningrad). Tsitologiya, 10: 471-5 (Apr. 1968). (In Russian).**

Changes in the ultraviolet fluorescence of blood and bone marrow cells of rats were studied at early and late times after x irradiation. At early times after irradiation the increased level of UV fluorescence was revealed on both live and dead cells. At late period after irradiation some changes in UV fluorescence could be registered only on live cells. The increased intensity of UV fluorescence followed by irradiation was the result of some structural disturbances that disappeared with the given cell generation. The increased intensity of UV fluorescence at late times after irradiation was conditioned by hereditary changes in the irradiated cells realized in metabolic changes. (auth)

33932 CORRELATION OF ROSE BENGAL CLEARANCE AND HISTOPATHOLOGIC CHANGE OF SHEEP LIVERS DAMAGED BY ^{237}Np. **Wood, D. H.; Murray, J. L.; Palotay, J. L. (General Electric Co., Richland, Wash.). Contract AT(45-1)-1350. Amer. J. Vet. Res., 29: 1103-8(May 1968).**

There was close correlation between results of the rose bengal liver function test and histopathologic changes in serial biopsies of liver of sheep given the hepatotoxic agent, ^{237}Np. Cellular damage was most severe and blood clearance of the dye was slowest on the 4th day postinjection. Cellular repair was evident by the 6th day and was almost complete by the 10th day. (auth)

33933 ROLE OF THE MACROMOLECULES IN THE DEVELOPMENT OF ELEMENTARY RADIATION INJURIES. **Nagy, Eva J. (Magyar Tudomanyos Akademia, Budapest). Magy. Radiol., 20: 70-7(Apr. 1968). (In Hungarian).**

Modern concepts of radiation biochemistry were applied in studies on the chemical alterations observed in the initial phase of uv radiation injury, especially in the macromolecular structures of the cell. Emphasis is placed on effects of uv irradiation on the synthesis of DNA. (auth) (TSS)

33934 NEOPLASMS IN THE ANN ARBOR SERIES OF THYMUS-IRRADIATED CHILDREN: A SECOND SURVEY. **Pifer, J. W.; Hempelmann, L. H.; Dodge, H. J.; Hodges II, F. J. (Univ. of Rochester, N. Y. Univ. of Michigan, Ann Arbor). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 13-18(May 1968).**

The current incidence of neoplasms in a series of 958 persons treated with x radiation in infancy and childhood for thymic enlargement was determined by a second survey seven years after the original study in 1958. The eight cases of thyroid neoplasms and, probably, the five of osteochondromas are in excess of the number of cases expected in a population of comparable size and age distribution. The total number of malignancies, however, was slightly, but not significantly, increased. These observations are consistent with most other studies of populations irradiated with x rays in childhood. The comparatively low incidence of thyroid tumors in this series as compared with others irradiated in childhood and infancy is probably the result of careful port placement which reduced the exposure of the thyroid gland to small doses of scattered x rays. (auth)

33935 EFFECT OF A FRACTIONATED DOSE OF UV-RADIATION ON CHROMOSOMES OF MAMMALS. Antoshechkin, A. G. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR, 178: 707-10(Jan. 21, 1968). (In Russian).

Fibroblastic cells of the Chinese hamster were irradiated with a 60 or 50 erg/mm^2 dose of uv with $\lambda = 260$ mμ at the early S stage of cell division, which is the most sensitive to uv radiation. The cells were treated with ^{3}H-thymidine for 10 minutes before the uv exposure. The uv dose was fractionated into two half-doses with the incubation time between the half-doses varying from 2 min. to 3 hr. The cells were fixed 24 hr after the first irradiation. The number of chromatid exchanges per cell was counted in metaphase. The frequency of chromatid exchanges decreased with increasing time between half doses up to 30 min, but at one hour the frequency in chromosomal changes attained a level observed with a single dose. The results are explained on the basis of a change in the radiosensitivity of the chromosomes. After administration of the first dose it is assumed that the activity of processes related to chromosomal replication are lowered over a period of about 30 min. Thus the radiosensitivity and frequency of chromosomal aberrations are also lowered. With time the activity of these suppressed processes is restored, and an increase of chromosomal aberrations is noted. (TTT)

33936 CHANGES IN THE LUNG AS A RESULT OF ROENTGENOTHERAPY OF CANCER OF THE MAMMARY GLAND. Vergazova, R. U.; Korsunskii, V. M. (Moscow Oncological Inst.). Vop. Onkol., 14: No. 1, 35-7(1968). (In Russian).

The authors report some alterations in the lung tissue revealed in 118 patients as a result of x ray therapy of cancer of the mammary gland. (auth)

33937 EFFECTS OF SINGLE DOSE X-IRRADIATION ON THE PIGMENT CELL SYSTEM OF THE PET MOUSE LEG SKIN. Reams, Willie M. Jr.; Schaeffer, Barry E. (Medical Coll. of Virginia, Richmond. Univ. of Richmond, Va.). J. Invest. Dermatol., 50: 297-300(Apr. 1968).

Young mice of the PET strain have a conspicuous number of dermal melanocytes but are deficient in melanotic epidermal melanocytes. When the hind limb of PET mice was given a single dose of x radiation, depending on the dose (200 to 7,000 R), the dermal pigment cells responded by establishing a melanocyte density which remained constant even at high radiation levels. Epidermal melanocytes were provoked only within the 2,000 to 3,000 R range. It is suggested that the data give support for the radiation-induced melanocyte increases to be a result of activation of resident, latent pigment cells. (auth)

33938 INFLUENCE OF A SINGLE AND FRACTIONAL IRRADIATION ON THE DEVELOPMENT OF PRECANCEROUS AND EARLY TUMOR PROCESS IN THE OVARIES OF MICE. Gubareva, A. V. (Central Research Roentgen-Radiological Inst., Moscow). Byull. Eksp. Biol. Med., 65: No. 4, 83-4(Apr. 1968). (In Russian).

A comparative study of a single (200 R) and fractionated doses of radiation (50 R × 4) of the ovaries of common white mice showed that the same qualitative effects were produced by both regimens. The effect following fractionated treatment was clearly seen only during the first months after irradiation. Hyperplastic and pretumor processes leveled off at later periods, except for the blastomatous changes. The difference in incidence of ovarian tumors appearing during the first year after fractionated (5.0% ± 1.6) and single (9.7% ± 1.3) irradiation was statistically significant. (auth)

33939 RADIOBIOLOGICAL BASES FOR A THERAPEUTIC USE OF FAST NEUTRONS. Silini, G. (Centro di Studi Nucleari della Casaccia, Rome). Med. Nucl. Radiobiol. Lat., Suppl. 1, 523-37(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Data pertaining to the radiobiological effects of neutrons are reported with special emphasis on the inactivation of cells irradiated in vitro and in vivo under oxygen or anoxia. Finally, some results are discussed of the analysis of a theoretical model on the action of neutrons on cell populations. These data allow rough quantitative estimates of the advantages to be expected in neutron radiotherapy. (auth)

33940 EFFECT OF PANIRRADIATION WITH FAST NEUTRONS IN ALBINO MICE. Juliani, G.; Randaccio, M.; Sannazzari, G. L.; Torretta, A. (Univ., Turin). Med. Nucl. Radiobiol. Lat., Suppl. 1, 517-20(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Using a linear accelerator of 14.2 MeV, a group of eight albino mice were panirradiated with fast neutrons at doses calculated to be about 300 and 87 rad. Alterations revealed by microscopic examination of skin, testicle, kidneys, liver, pancreas, and thymus are discussed. (auth)

33941 RADIOSENSITIVITY AND LEARNING CAPACITY OF RATS. di Paola, M. (Centro Studi Nucleari della Casaccia, Rome). Med. Nucl. Radiobiol. Lat., Suppl. 1, 541-53(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The significant relation between individual variations in radiosensitivity and the degree of activity of the central nervous system of small mammals is discussed. In order to obtain other data for an interpretative model of this observation, an attempt was made to analyze a larger number of behavior variations in learning capacity, motivation and emotivity. This not only allowed a comparison of radiosensitivity (lethal effect and behavioral characteristics of the population), but served to assess whether the previously established relation is because of one or more behavioral factors. Statistical analysis of the results allowed individualization of established typological aspects to which statistically significant differences in radiosensitivity corresponded. The importance of emotive and motivational characteristics was shown to play a prominent role in radiosensitivity. The extent of participation of these two characteristics appeared to change according to different conditions of irradiation. (auth)

33942 PHYTOHAEMMOAGGLUTININ AND IRRADIATION OF HEPATOMA ASCITE CELLS IN VIVO AND IN VITRO. Dragoni, G. (Univ., Milan. Univ., Pavia, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 554-61(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The effect of ionizing radiation on hepatoma ascite cells in rats treated with phytohaemoagglutinin (PHA) was examined. Radiation treatment inhibited the formation of the nucleolus in cells under the undifferentiating stimulus of PHA in vivo and in vitro; clear nuclear and cytoplasmatic modifications were symptomized by rarefaction of chromatin and by the breakdown and lysis of nuclear substance. The metabolic and biochemical inhibition of RNA was synthesis was held to be the main factor in these changes. (auth)

33943 PARTICULAR ASPECTS OF THE PROBLEM OF R.B.E. Greco, S.; Musumeci, S.; Spina, F.; Cordaro, S.; Loreto, C. (Univ., Catania, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 567-602(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Variations in RBE values of x rays, ^{60}Co γ rays, 17.5 MeV electrons and 17.5 MeV x rays were studied using the following tests on Swiss albino rats: variations in the weight of the spleen, liver, and gonads; variations in ^{32}P uptake by the nucleic acids of the cells of these organs; and histological variations in the spleen, liver, and gonads. For each test situation, variations in RBE values taken from data obtained at the time of irradiation of the particular organ and average RBE values taken from data obtained at different intervals of time after irradiation were statistically analyzed. The validity of RBE values obtained in relation to different methods of studying the same biological material was examined, and the evaluation of RBE in relation to evolution of a radiobiological phenomenon was assessed. The validity of global values of RBE obtained by complex evaluation of different radiobiological phenomena was also examined. (auth) (TSS)

33944 SOURCES OF VARIABILITY IN RESPONSE TO PANIRRADIATION (INTRODUCTION TO COMPARISON TESTS). Cittadini, G.; Ricci, C.; Oliva, L.; Pallini, V.; Stuart, C. (Univ., Siena, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 3-82(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The requirements that must be met for research and study of radioprotective and radiosensitizing substances are discussed in relation to experimental variables: survival, radiation dose, the animal, and method of analysis of data. Criteria for the evaluation of such a research program are presented. (B.S.L.)

33945 OBSERVATION ON THE RADIOBIOLOGICAL EFFECTS OF IRRADIATION ON RAT OVARIES DURING INHIBITION OF OVULATION INDUCED BY SYNTHETIC PROGESTATIVES ASSOCIATED WITH ESTROGENS. Pompili, G.; Roseo, B. (Ospedale Maggiore, Milan). Med. Nucl. Radiobiol. Lat., Suppl. 1, 476-84(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The effects of radiation on the ovaries of albino rats during hormone treatment with synthetic progesterones associated with estrogens were studied. Vaginal smears and histological analyses of the ovaries, uterus, and suprarenal glands revealed no significant interaction between ionizing radiation and synthetic progesterones but only an association of effects. A single exposure dose of 600 R to the ovaries of pubescent female albino rats did not elicit definite modifications in estrus within a 120 day period; however, histological examination showed significant qualitative alterations only a short time after irradiation. (auth)

33946 EFFECTS OF RADIATION ON EXTRACELLULAR CONNECTIVE TISSUE COMPONENTS. Prodi, G. (Univ., Bologna). Med. Nucl. Radiobiol. Lat., Suppl. 1, 370-94(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The study of radiation-induced alterations in connective tissue has hitherto been approached morphologically. The effects on cellular components (particularly fibroblasts and mastcells), on extracellular structured components, on the so-called amorphous parts, and on the capillaries were examined. Data showed the importance of these alterations as concerned both immediate and delayed effects of radiation, namely sclerosis. These studies also showed that problems of notable interest and general importance, such as radioinduced aging, can be attributed at least in part to the action of radiation on connective tissue. The basic data concerning radiochemistry of components of connective tissue, necessary for a pathogenetic clarification of the problem, are still however rare and difficult to interpret. Relevant published data are examined and the possibility of elaborating some hypothesis on resulting alterations is discussed. (auth)

33947 THE RELATION BETWEEN BIODOSE, TIME OF LATENCE, AND TIME OF REPAIR IN RADIONECROTIC PROCESSES. Bistolfi, F. (Univ., Genoa). Med. Nucl. Radiobiol. Lat., Suppl. 1, 359-66(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Chrono-biodosimetric evaluation of cases of skin and mucous radionecrosis allowed a greater objectivity in assessing the interconnection between dose, irradiated area, and total time of treatment. The concept of radiolesive percentual relationship is discussed on a casuistic basis in six cases of radionecrosis (5 skin and 1 mucous) cured only by drugs, a particular development was noted in the connection between biodose/tissue (in radiolesive percentual relation), time of latence and time of repair of the above necrotic processes. It is suggested that between the three quantities, a double inverse proportion subsists: respectively between the radiolesive percentual relationship and the time of latence and between the time of repair and that of latence. (auth)

33948 MORPHOLOGICAL ASPECTS OF THOROTRAST PATHOLOGY. Grampa, G. (Univ., Milan). Med. Nucl. Radiobiol. Lat., Suppl. 1, 352-8(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The salient features of the well defined chapter of human and experimental pathology of Thorotrast are described; the microscopic and ultrastructural features of Thorotrast-irradiated tissues are included. (auth) (TSS)

33949 HEMATOLOGICAL ASPECTS AND HEPATIC FUNCTIONALITY AFTER ENDOCAVITARIAL, INTERSTITIAL, AND ENDO-ARTERIOUS ADMINISTRATION OF ^{32}P. Abrate, M.; Santoro, L.; Baiotti, G.; Nadali, L. (Univ., Turin). Med. Nucl. Radiobiol. Lat., Suppl. 1, 339-43(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The behavior of blood constituents and of the liver after endocavitarial, interstitial, and endoarterial administration of ^{32}P was studied in patients who were between 50 and 70 years of age and in poor nutritional condition. Pleural neoplastic effusions following breast cancer were treated endocavitarially with ^{32}P in the form of a colloidal complex. Metastatic carcinosis following breast cancer was treated by inactivation of the hypophysis with pellets of ^{32}P. Cancer of the tongue and inoperable cancers of the uterus and breast were treated by regional endoarterial application of resin microspheres that were tagged with ^{32}P and ^{51}Cr. Controls, made before any operation and after periods varying from two to three months, showed that the β activity of ^{32}P did not significantly alter either hematopoiesis or liver function. (auth) (TSS)

33950 FUNCTIONAL DAMAGE DURING EXPERIMENTAL RADIOINDUCED NEPHROPATHY. Laddaga, M. (Univ., Pisa, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 330-8(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The kidney residue in mononephrectomized dogs, before externalization of the organ, was exposed to single doses of 4,000, 3,000, 2,000 and 1,200 R, respectively. Only at the last dose did the animals survive long enough to allow the study of the kidney reaction with various functional tests. Data accumulated over three months of observation showed that at even the lowest doses, alterations were rapid and severe while there was a possibility of later repair of functional damage that was apparently related to the regenerative capacity of the tubular epithelium. (auth)

33951 POSTIRRADIATORY MODIFICATIONS OF HUMAN VESICAL MUCOUS. de Dominicis, R.; Nori-Bufalini, G.; Grechi, G.; Bongi, G. (Univ., Florence). Med. Nucl. Radiobiol. Lat., Suppl. 1, 323-9(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Radiation effects on the vesical mucous of man following therapy are discussed. Cystoscopical and histological examination of bioptic fragments taken during and after therapy were made. (auth)

33952 EFFECTS OF IONIZING RADIATION ON THE HUMAN KIDNEY. Bollini, V.; Miceli, R.; Trenta, A.; (and others) (Univ., Bologna). Med. Nucl. Radiobiol. Lat., Suppl. 1, 299-322(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

In a study of 44 patients irradiated for cancer on areas including healthy kidneys, numerous tests (functional, morphological, histochemical, ultrastructural, radiological, isotopical) permitted the following conclusions: From 4 months up to 16 years after irradiation with renal doses varying from 250 to 3000 rad, neither clinical symptomatology nor the usual laboratory tests revealed appreciable renal damage. Even the most detailed nephrological researches revealed no lesions except for slight changes in the glomerular filtration rate in the renography. Renal biopsy on the other hand documented sclerotic alterations mainly in the interstitial tissue. The extent of the alterations did not appear related to the time elapsed after irradiation nor to the age of the patient, but relative rather to the renal doses. A distinct fibrosis was in fact recognized in 88% of cases in which kidneys were subjected to over 2500 rad. (auth)

33953 MALE GERM CELLS RADIOSENSITIVITY IN RAT. Monesi, V. (CNEN, Rome). Med. Nucl. Radiobiol. Lat., Suppl. 1, 279-80(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The response of male germ cells of the rat to radiation is summarized. Previous research showed that the sensitivity of mature type A spermatogonia form a heterogenous population of cells rather than that of immature type A spermatogonia and that the survival curve of the latter after irradiation is of the heterogeneous type. This heterogenicity cannot be due solely to the possibility that type A spermatogonia form a heterogenous population of cells having different levels of sensitivity, since the heterogeneity is traceable in all the stages of the cycle of the seminiferous epithelium. The results reported herein are based on the assumption that a contributing cause for the heterogeneity could be the change in radiosensitivity during the cellular cycle. By combining x irradiation at doses of 20, 50, 100, 200 or 300 R with administration of tritiated thymidine one hour before exposure to x rays it was shown that: Spermatogonia lethally damaged by radiation died (after cessation of the mitotic block) as soon as they reached a well defined and critical stage of the cellular cycle independently from the stage in which they happened to be at the moment of irradiation. The stage at which type A or intermediated spermatogonia died was the advanced interphase or the initial prophase; type B spermatogonia died at the anaphase-telophase. The period following synthesis of DNA (G_2) of the cellular cycle was resistant to radiation, and the period of synthesis (S) was the sensitive stage. On the basis of these results and those of other research, a hypothesis was formed for the interpretation of the response of spermatogenesis to radiation. (auth)

33954 PATHOLOGY OF CYTOKINESIS BY X RAYS. Rondanelli, E. G.; Trenta, A.; Vannini, V.; Gerna, G. (Univ., Pavia, Italy. Univ., Bologna). Med. Nucl. Radiobiol. Lat., Suppl. 1, 225-39(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Dynamic aspects related to formation of x-ray induced cytological anomalies in erythroblasts of tritons were studied by phase contrast microcinematography and microphotography, small radiation doses were used. The cytological anomalies were classified as follows: complete absence of cleavage furrow; more or less fugitive appearance of a cleavage furrow (successive appearances with regression); appearance of one or more furrows that closed atypically. Cytological anomalies consequent to the above troubles were analyzed. Their pathogenetic bases were examined in relation to the latest theories on the cytokinetic process. (auth)

33955 CHROMOSOME MODIFICATIONS OF HUMAN LYMPHOCYTES AFTER STRESS. Lupo, M.; Magnani, C. (Ospedale Maggiore, Novara, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 208-24(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Chromosome charts were studied of 119 cases that had undergone traumatic, surgical, or radiotherapeutic stress. In 25 surgically operated cases and 24 suffering slight trauma, no alterations were observed, while they were found with trisomy in 6 to 12; 1 to 3; 16 to 20 in 28 cases out of 35 with severe trauma accompanied by shock. In 25 cases treated with radiotherapy, translocation and dislocation of fragments were noted. (auth)

33956 PROBLEMS OF QUANTITATIVE EVALUATION OF CHROMOSOMIC ALTERATIONS IN PARTIAL BODY IRRADIATION. Biagini, C.; Brancadoro, P.; Siciliano, A. (Univ., Rome). Med. Nucl. Radiobiol. Lat., Suppl. 1, 202-7(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

Considerable material has recently been accumulated on the significance of chromosome aberrations as a result of somatic damage through human irradiation. The most interesting data, resulting from research on leukocytes of peripheral blood during culture, concern the development of chromosome aberration in people exposed for medical or professional reasons and the effect of a single total or partial exposure. A notable development of the application of irradiated peripheral blood culture methods in man is represented by quantitative evaluation of chromosome aberrations to arrive at a dose-effect correlation. This type of search involves identification of the most significant physicobiological parameters, and of the factors promoting the appearance of aberrations. In different exposure conditions the effects could be related to a dose in the form of skin doses, integral doses, hemopoietic organ doses, or circulating blood doses. Research was conducted on patients undergoing radium treatment on various body regions. Blood samples were taken 24 or 72 hours after a single irradiation and examined after 72 hours incubation in culture. A comparison between samples can furnish useful information on radiation effects on body areas characterized by different content in hemopoietic tissue and circulating blood. The correlation between various significant parameters and the factors that could influence analysis of the phenomenon are discussed. (auth)

33957 HYSTOENZYMATIC AND ULTRASTRUCTURAL MODIFICATIONS OF COLLOIDAL ^{198}Au ON HEPATIC CELLS OF RATS. Longo, G.; Barone, P.; Blandino, G.; Carrozza, G.; Inferrera, C. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., Suppl. 1, 156-72(1966). (In Italian).

From Conference on Radiobiology, Modena, Italy. See CONF-661063-(Suppl.1)(Vol.1).

The action of injections of radioactive colloidal gold on the hepatic parenchyma of rats in doses approximately equivalent to those used in human scintigraphic diagnosis was investigated. Using normal methods for morphologic examination, no pronounced alterations were apparent in the liver. Histochemical analysis revealed an early increase of cytoplasmatic ribonuclease that occurred 40 hours following injection, and that returned to normal after 10 to 20 days. Ultrastructural examination confirmed the histochemical findings, showing a conspicuous increase of both free ribosomal granulations and of those associated with the reticulum membrane. The observed increase of ribonuclease seemed to indicate that injection of radioactive colloidal gold resulted in hepatic stimulation of protein synthesis; this was confirmed in the results of the histoenzyme examination. In the Kupffer cells aspects were observed that could be attributed to assimilation of particles of colloidal ^{198}Au through lysosomial phenomena. Analogous aspects appeared later in the hepatocytes associated with aspects of elimination in the small biliar vessels. (auth)

33958 ELECTRON-MICROSCOPIC STUDY OF RADIATION-INDUCED DAMAGE AND ITS EVOLUTION IN EHRLICH TUMOR CELL MITOCHONDRIA. Benassi, E.; Piccotti, F. (Univ., Turin). Med. Nucl. Radiobiol. Lat., 10: No. 1, 51-6(1967).

The morphology, number, and section area of the mitochondria of in vivo and in vitro Ehrlich tumor cells were investigated at different times after exposure to doses of 500 to 5,000 rad x radiation. Electron-microscopic micrographs of the cell sections revealed early mitochondrial changes. The greater the absorbed dose, the earlier did these changes appear. All the observed mitochondria were altered immediately after irradiation with 5,000 rad, the changes consisting in an increase of the size of the mitochondria, rupture of the membrane, and subsequent development of the organella into vacuoles. After 24 hours, the percentage of swollen mitochondria was found to be proportional to the absorbed dose. Other, unusually small mitochondria were observed besides the vacuolated mitochondria in some cells after 72 hours. Differences were found between in vivo and in vitro tumor cells, consisting in a smaller number of mitochondria and a greater radiosensitivity of in vitro cells. The hypothesis that cellular radiosensitivity may be related to the number of mitochondria and to the possibility of their recovery is suggested. (auth)

33959 THE BEHAVIOR OF THE ESTRAL CYCLE IN THE ALBINO RAT FEMALE AFTER IRRADIATION OF THE OVARIES, STUDIED BY THE TECHNIQUE OF A SCRAPING OF THE VAGINAL SMEAR. Pompili, G.; Roseo, B. (Istituto di Radiologia e Medicina Nucleare, Milan). Med. Nucl. Radiobiol. Lat., 10: No. 1, 69-74(1967). (In Italian).

The direct x irradiation of the ovaries of twenty mature female albino rats did not cause significant variation of the estral cycle compared with an equal number of non-irradiated animals, within a period of time of 210 days from the irradiation, and for doses of exposure of 600 R. It was concluded that, within the limits of the experiments, irradiation did not significantly change either the estrogenic activity of the ovarian follicles or their development. (auth)

33960 INFLUENCE OF CHRONIC IRRADIATION ON THE SUPRARENALS AND OVARIES IN RATS. Van Caneghem, P.; Bacq, Z. M. (Univ., Liege). Compt. Rend. Soc. Biol., 161: 2309-10(1967). (In French).

Chronic irradiation of young female rats with ^{137}Cs γ rays to 1600 rad at 0.32 rads/hr did not affect the adrenal glands or the uptake of ascorbic acid; however, it induced anemia and ovarian complications. (R.V.J.)

33961 CONDITION OF ENDOCRINE SYSTEM IN EXPERIMENTAL ANIMALS SUFFERING FROM CHRONIC RADIATION INJURIES. Strel'tsova, V. N. Med. Radiol., 12: 83-92(Oct. 1967). (In Russian).

The condition of endocrine systems in experimental animals suffering from chronic radiation injuries is reviewed. Data on the frequency of obesity and endocrine abnormalities in rats following a single exposure to 120 MeV protons and the content of estrogens in the urine of dogs exposed to ^{90}Sr are tabulated. (R.V.J.)

33962 RETINAL INJURY BY RUBY AND NEODYMIUM LASER. Geeraets, Walter J. (Medical Coll. of Virginia, Richmond). Acta Ophthalmol., 45: 846-51(1967).

This investigation is concerned with the histopathological effect of ruby laser radiation on the retina and choroid of the chinchilla grey rabbit eye. Although ocular absorption characteristics vary greatly for ruby wavelengths (694.3 nm) and neodymium (1060 nm), the primary site of permanent chorioretinal injury for both wavelengths is considered to be the retinal pigment epithelium. The probability of pathologic effects on the ocular media and the neural layers of the retina is greater for the neodymium wavelength because of the greater absorption at this wavelength in these structures. (auth)

33963 FINE STRUCTURE OF THE NUCLEI OF THE DUODENAL CRYPT CELLS AFTER X-IRRADIATION. Hugon, J.; Borgers, M. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Amer. J. Pathol., 52: 701-23(Mar. 1968).

The nuclei of the stem cells of the crypt were examined after supralethal x irradiation of adult mice. An early reaction of some nucleoli with formation of nucleolar caps was observed. Afterwards, nuclear blebs appeared in the form of large electron-lucent vacuoles progressively separated from the nuclei. Other nuclei degenerated rapidly. These alterations were discussed in relation to the radiosensitivity of the cell cycle, and to the cytoplasmic modifications. (auth)

33964 GALACTIC RADIATION HAZARD IN LONG-TERM SPACE MISSIONS. Schaefer, Hermann J. (Naval Aerospace Medical Inst., Pensacola, Fla.). Aerosp. Med., 39: 271-6(Mar. 1968).

For deep space ventures of the future involving mission times of months or even years, the accumulated exposure from galactic radiation is no longer negligible. Since the development of chronic radiation injury from extended exposure at low dose rates greatly depended on Linear Energy Transfer (LET), galactic radiation exposure had to be assessed in terms of both absorbed doses in millirads and dose equivalents in millirems. While fairly reliable data on the primary galactic radiation were available, the so-called build-up phenomenon, i.e., the local production of secondaries in the vehicle material and body tissues themselves, was not well understood at present. Using upper limit estimates where information was incomplete led to a total body dose for man of 40 millirads/day and 120 millirems/day for 2-pi incidence of the full flux of galactic radiation at solar minimum. Assessment of the dose equivalent was based on the officially recommended Quality Factor (QF) of the International Commission on Radiological Protection. Applying the best available data on life shortening for chronic irradiation led to an effect of 25 per cent in the sense that man's life would be shortened by one-fourth of the time spent in space. Microbeam effects from heavy nuclei of low energies that might enhance the damage were not considered in this assessment since no data on chronic injury from sustained total body microbeam irradiation at low dose rates were available. (auth)

33965 EFFECT OF IONIZING RADIATION ON THE HEALTH OF EXPOSED WORKERS. Pazderova, J.; David, A.; Roth, Z. Int. Arch. Gewerbepathol. Gewerbehyg., 23: 127-40(Feb. 28, 1967). (In German).

The authors analyse the results of periodical examinations performed since 1943 at the Clinic of Occupational Pathology in Prague on 992 persons exposed to ionising radiation. 78 persons (mostly physicians) had X-ray dermatitis of the hands, while leucopenia was found in 47 cases and radiation cataract in 5 cases. The mean leucocyte, neutrophil and lymphocyte counts were reduced, especially in doctors; in cases of industrial exposure, no statistically significant difference as compared to controls was noted. Thus the mean haematological values may be used to assess the effect of exposure on health. The changes were unrelated to length of exposure.

33966 HEMATOLOGICAL CHANGES IN OCCUPATIONALLY RADIATION-EXPOSED PERSONS IN RELATION TO PERSONAL DOSIMETER VALUES. zur Horst-Meyer, Horst (Humboldt Univ., Berlin). Strahlentherapie, 135: 428-36(Apr. 1968). (In German).

Studies done on persons who were exposed to radiation during their work revealed some constant hematological modifications. Effects were still noticed one year after exposure. Possible pathological events that might have caused these results are discussed. (auth)

33967 THE INFLUENCE OF X RADIATION ON VITALITY SIGNS OF DROSOPHILA MELANOGASTER. IV. INVESTIGATIONS ON FERTILITY. Noethel, Horst (Freie Univ., Berlin). Strahlentherapie, 135: 493-99(Apr. 1968). (In German).

The influence of x rays on fitness components was studied in D. melanogaster by means of the fertility after irradiation; doses ranged from 0 to 11 kR. The dependency of the effects measured on the stage exposed was confirmed. In the males, the frequency of induced dominant lethals decreased from spermatocytes to spermatids and spermatozoa and was lowest in the spermatogonia. However, the aspermatism induced at 6 kR and above points rather severe damages in the spermatogonia. In the females, the developmental rate of the eggs laid increased from stage 14-oocytes to immature cysts and was highest after exposition of oogonia. In both sexes, permanent sterilization was induced at 11 kR. After exposition of both sexes simultaneously, there was in general an additive action of the damages induced in males and females. However, after irradiation of postgonial stages the frequency of the effects measured was reduced by interactions between the two genomes exposed. Irradiation of germ cell stages resulted predominantly in prelarval mortality. For this type of mortality, the dose action curve was sigmoid after exposition of more mature stages whereas it was linear after irradiation of gonial cells. The postembryonal mortality increased linearly with increasing dose after exposition of more mature stages whereas it was not induced at all in gonial cells. The different dose action relationships are discussed. (auth)

33968 STRAIN DIFFERENCES IN MALFORMATIONS OF THE EXTREMITIES OF THE MOUSE FETUS CAUSED BY X RADIATION, HYPOXIA, OR HYPERVITAMINOSIS-A OF THE MOTHER DURING PREGNANCY. Kameyama, Yoshiro (Nayoga Univ., Japan). Annu. Rep. Res. Inst. Environ. Med., Nagoya Univ., 13: 49-55(1965).

Strain differences were observed in the manifestation of artificially induced malformations on the bones of extremities in ddN and CF1 strain mice. X radiation, 200 R; hypoxia, reduced atmospheric pressure, to about 225 mm Hg, for 5 hr; and vitamin A, injection of 15,000 I. U./mouse, were used as teratogens to produce developmental anomalies of the skeletal system. There was no qualitative difference between the two strains in manifestation of the anomalies due to x radiation, hypoxia, or hypervitaminosis A. In the experiments with x radiation and with hypoxia, incidences of anomalies were distinctly lower and the degree of abnormality was also less intensive in the CF1 strain, compared with those in the ddN strain. The malformations in the two strains showed no difference due to a time lag of the sensitive stage for limb formation. In experiments with hypervitaminosis A, a strain difference was not detected in the degree of maldevelopment in the final results, since the dose administered was too high and the developmental disturbances of long bones were extensive in both strains. However, there were predominant differences due to a time lag of the sensitive stage between the two strains. The sensitive stage for anomalies of extremities was the 11th to 12th day of pregnancy in the ddN strain and the 10th to 11th day stage in the CF1 strain. (BBB)

33969 CORRELATION OF DOSE OF X RADIATION TO THE RAT THYROID GLAND WITH DEGREE OF SUBSEQUENT IMPAIRMENT OF RESPONSE TO GOITROGENIC STIMULUS. Gibson, J. M.; Doniach, I. (London Hospital). Brit. J. Cancer, 21: 524-30(Sept. 1967).

Thyroid carcinoma in children and young adults could result from exposure to a few hundred rads of radiation to the thyroid in infancy or early childhood. It was pertinent to the analysis of the carcinogenic action of radiation to assess other biological effects on the thyroid of this order of radiation. Whether there was a threshold of x-ray dose that suppressed the goitrogenic response, said to lie between 200 and 400 rad, according to conflicting results, was investigated in rats. After irradiation of the thyroid, the rats were given an antithyroid drug. In unirradiated controls this goitrogenic challenge for four weeks increased the thyroid weight two to three times. Comparison of the mean thyroid weight of goitrogen-challenged irradiated rats with that of goitrogen-challenged controls revealed some impairment of response. Five groups of 20 rats each were irradiated with 0, 50, 250, 500, and 750 rad, then given a 28-day methylthiouracil/propylthiouracil goitrogenic challenge. Impairment of thyroid response was found at doses over 500 rad. The effect of 250 rad was borderline and could not be proved statistically significant. The results agreed with clinical studies suggesting that thyroid tumors could be induced by doses of a few hundred rads to the neck in infancy or early childhood, and supported the hypothesis that radiation carcinogenesis resulted from nuclear damage. (BBB)

33970 EFFECT OF PATERNAL IRRADIATION ON BODY WEIGHT AND DEPTH OF FAT IN PIGS. Cox, D. F. (Iowa State Univ., Ames). Contract AT(11-1)-707. Genetics, 58: 271-4(Feb. 1968).

The effect of spermatogonial x irradiation on the weight and depth of fat at 154 days in the first generation was studied in over 21,000 pigs from two breeds. The pigs from x irradiated spermatogonia weighed less and had less fat than contemporary controls, but the treatment effects were small and not significant except in Durocs where a shift of 0.85 kilograms, representing one per cent of the average weight, was detected. No significant trends in the variance among pigs within a litter were noted in the various treatment groups. (auth)

33971 EFFECT OF INTERNALLY INJECTED RADIOISOTOPES ON THE CONNECTIVE TISSUE IN THE INDIAN CATFISH, HETEROPNEUSTES FOSSILIS BLOCH. Srivastava, Pratap N.; Ram, Sewbarath (Univ. of Rajastha, Jaipur, India). Strahlentherapie, 135: 479-85(Apr. 1968).

The connective tissue of the irradiated gastrointestinal tract showed a morbid alteration of the cellular elements that involved dense collagen proliferation and hyalinization. Differential staining reactions elucidated the nature of a pathogenetic change that was referred to as pseudoelastic or elastic degeneration of the collagen. A marked increase in acid mucopolysaccharides of the extrafibrillar intercellular matrix, similar to that seen in many connective tissue disorders, occurred. (auth)

Radiation Effects on Plants

Refer also to abstracts 33748, 33749, 33773, 33778, 33783, 33784, 33794, 33798, 33863, 33864, and 33904.

33972 RESPONSE OF BACTERIAL SPORES AND MICROCOCCUS RADIODURANS TO ULTRAVIOLET IRRADIATION AT LOW TEMPERATURES. Ashwood-Smith, M. J.; Copeland, J.; Wilcockson, J. (Medical Research Council, Harwell, Eng.). Nature (London), 217: 337-8(Jan. 27, 1968).

It was found that at low temperatures spores of Bacillus subtilis and vegetative cells of Micrococcus radiodurans show paradoxical changes in sensitivity to the lethal effects of ultraviolet irradiation. (auth) (UK)

33973 X-RAY SENSITIVITY OF THE X_1 GENERATION OF L. ESCULENTUM MILL. "SPERLS ZUKUNFT" VARIETY. Zolyneak, C. C. An. Stiint. Univ. Al. I. Cuza, Iasi, Sect. II, 12: 19-25(1966). (In German).

Dried seeds of tomato, Lycopersicon esculentum, with a 7 to 9% humidity, were exposed to 10 to 43 kR x ray doses. The length of roots and hypocotyls, pollen grain fertility, seed content of fruit, the number of plants undergoing a whole living cycle, the number of fungus-infested fruits, and the number of mature or nearly mature fruits was found to decrease with the increase in x ray doses. No changes were recorded in fruit size. (auth) (Romanian Sci. Abstr.)

33974 THE GERMINATION CAPACITY OF X-IRRADIATED SEEDS OF SOME VARIETIES OF ALLIUM CEPA L. Srb, Vladimir (Charles Univ., Hradec Kralove, Czechoslovakia); Hora, Jiri. Genet. Slechteni, 2: 161-8(July 1966). (In Czech).

The effect of 100 to 5000 R doses of x radiation on seed germination of 5 varieties of the onion, Allium cepa L., was studied. A statistically significant stimulative effect of the 100 R dose was manifest in the Kasticka and Vsetatska varieties (5 and 10%, respectively, as compared to the controls). The 1000 R dose was also stimulative by 5.9% in the Kasticka variety; the 5000 R dose exerted no significant effect. In the Kuetoslavska, Obrovska zluta, and Moravanka varieties there was no apparent radiation effect. It was concluded that the radiosensitivity of onion seeds was dependent on variety. (auth) (TSS)

33975 THE GERMINATING CAPACITY OF THE SEEDS OF SOME GRASS VARIETIES OF THE MEADOW-GRASS FAMILY (POACEAE) AFTER IRRADIATION WITH X-RAYS. Gaborcik, S.; Srb, V. Genet. Slechteni, 3: 101-8(Mar. 1967). (In Czech).

The effect of different exposures to x radiation (770 R–30,000 R) on the germinating capacity of the seeds of nine species of the meadow-grass family, Poaceae, was investigated. In all species the laboratory germinating capacity of irradiated and immediately tested seeds was lower compared with the corresponding data for non-irradiated controls. An exception was fiorin bent-grass, 84 percent of the seeds germinated after an exposure to 16,000 R. An exposure to 30,000 R may be considered as critical for the seeds of certain plant species. The effect of x radiation was shown in a different way according to whether the germinating capacity of irradiated seeds was determined immediately after irradiation or after 10 months in storage. In the former case, germinating capacity decreased by from 1 to 12 percent (according to the plant species) at an exposure to 770 R, and it decreased further in the case of higher exposures. In the second case, however, it was higher by from 11 to 16 percent, and that not only in the case of exposures to from 770 to 1,100 R, but in some cases (particularly in the case of fiorin bent-grass) also with higher exposures. The seeds of fiorin bent-grass irradiated and stored for 10 months germinated better in the case of all applied exposures (by from 2 to 13 percent) than in the control (82 percent) or in a test carried out immediately after irradiation, and that also after an irradiation with 30,000 R (84 percent), which was critical for irradiated and immediately germinating seeds of all other species (30 percent). (auth)

33976 GERMINATION AND SURVIVAL OF CONIFERS FOLLOWING CHRONIC GAMMA IRRADIATION OF SEED. Clark, G. M. (Univ. of Toronto); Sweaney, W. P.; Bunting, W. R.; Baker, D. G. Radiat. Bot., 8: 59-66(Feb. 1968).

Dry seeds of the following species: Jack pine, Black spruce, Red pine, Scotch pine, White spruce and White pine were exposed to ^{60}Co γ-irradiation for a period of 1–250 days. A dose-rate of 0.035 R/min for total doses to 12.6 kR was employed. Two parameters to assess radiation effects were studied, 30-day germination under laboratory conditions and 1-yr survival in the field. Germination was higher for all species under laboratory conditions than in the field. An approximate 10-fold range in sensitivity was found between White pine, the most sensitive ($LD_{50/30}$ 685 R), and Jack pine, the most radioresistant ($LD_{50/30}$ 6310 R). The highest exposures producing no inhibition of germination (LD_0) varied from approximately 400 to 3700 R. The lowest exposures preventing all germination (LD_{100}) varied from 1500 to 11,200 R. Survival of seedlings from irradiated seed, 1-yr post irradiation, showed White pine and White spruce to be most sensitive, with an LD_{50} of 575 R, and Jack pine the most radioresistant, with an LD_{50} of 2950 R. The LD_0 ranged from approximately 80 to 1160 R and the LD_{100} from 950 to 4300 R. (auth) (UK)

33977 ROLE OF NUCLEIC ACIDS AND OF PROTEIN IN THE RADIOSTIMULATION OF PLANT GROWTH. Crebinskii, S. O.; Fornyak, N. M.; Yatsevskaya, N. V. (Lvov State Univ.). Dokl. Akad. Nauk SSSR, 177: 717-19(Nov. 21, 1967). (In Russian).

Seeds of hybrid corn and garden radish were given a stimulating x ray dose of 750 R. The contents of nucleic acids, RNAase, total nitrogen, and protein nitrogen were determined in 3 to 5 day shoots from these seeds. The increase in plant weight with a stimulating radiation dose was also accompanied by an increase in water content (90.36% water in the non-irradiated plant compared to 91.5% water in the plants irradiated with a stimulating dose of 750 R; the water content was 86.9% at a dose of 25 kR which suppressed growth). Growth stimulation was accompanied by an increase in the RNA/DNA ratio. Growth suppression of the root system was accompanied by a decrease in the RNA/DNA ratio. Radiostimulation of plant growth is thus due to accelerated synthesis of RNA and protein. Irradiation of seed with stimulating doses activated the ribonuclease, and a suppressive dose decreased the ribonuclease content. (TTT)

33978 APPLICATION OF THE METHOD OF COPOLYMERIZATION FOR THE DETERMINATION OF THE FREE RADICAL STATE DURING IRRADIATION OF HIGHER PLANTS. Nor-Arevyan, N. G.; Avakyan, Ts. M.; Matevosyan, A. K. Biol. Zh. Arm., 20: No. 12, 24-8(Dec. 1967). (In Russian).

An attempt was made to find relations between the quantity of free radicals and the radiobiological effects at different oxygen pressures. The tests were made on the rootlets of beans and wheat. Plants before and after γ irradiation were submerged in crystallizers, previously filled with ^{14}C-labeled acrylamide. The irradiation was done in a special chamber at oxygen pressures of 0, 0.2, and 10 atm. No difference in activity was found between control and irradiated plants. Very detailed tests on the kinetics of the washing out of the labeled acrylamide showed that it was firmly combined with the biocomponents of the cell and did not appear inert as was shown in animals and lower plants. The results completely eliminated the possibility of using this method for free radical determination in higher plants. (tr-auth)

33979 EFFECTS OF X RADIATION ON PLANTS OF SUMMER SQUASH. Tonakanyan, G. A. (Erevan State Univ.). Biol. Zh. Arm., 20: No. 12, 73-6(Dec. 1967). (In Russian).

Experiments on summer squash were carried out. Seeds of the variety Gribovskii-37 were subjected to x radiation after having been submerged in ordinary tap water for 30 min 12 hrs before irradiation. The x irradiation caused an acceleration in growth of the seedlings in comparison with the controls of from 1 to 3 days. X irradiation also had some stimulating effect on the leaf size of the squash. The data showed that the leaves of plants grown from irradiated seeds, exceeded the leaves of control plants both in length and width. (tr-auth)

33980 AFTER EFFECTS OF SEED IONIZING IRRADIATION PRIOR TO SOWING ON THE GROWTH AND PRODUCTIVITY OF MAIZE IN GENERATIONS M_1, M_2, AND M_3. Ozol, A. M.; Peterson, E. K. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis, No. 12, 67-77(1967). (In Russian).

Growth, development, and productivity of M_2 and M_3 maize plants exposed to high doses of γ radiation and fast neutrons were more nearly normal than that of M_1 plants under the same conditions. Survival rate was higher and somatic mutations less frequent in succeeding generations. (H.G.D.)

33981 APPLICATION OF IONIZING IRRADIATION IN PLANT GROWING UNDER CONDITIONS OF LATVIA. Millers, A. (Latvian Biological Inst., Riga). Latv. PSR Zinat. Akad. Vestis, No. 12, 47-50(1967). (In Latvian).

The effects of ionizing radiation on plants are reviewed. The yield of maize, beans, radishes, and cucumbers following exposure of seeds to ^{32}P or ^{60}Co γ radiation is discussed. (R. V. J.)

33982 APPLICATION OF RADIOACTIVE IRRADIATION TO POPPY CULTURES. Tetenyi, Peter; Foeldesi, Dezso. Atomtech. Tajek., 11: 79-82(1968). (In Hungarian).

Considering the fact that poppy seeds exposed to lethal doses of ^{60}Co γ radiation sprout, but remain cotyledonous and perish in two to three weeks, a new method of poppy growing without thinning was developed. Exposed and unexposed seeds were mixed and seeded. The exposed seeds sprouted and helped the normal ones to break the soil surface, but perished in a short time. The time necessary to thin the plants could be decreased by 43 to 56.7%. (auth)

33983 TWO LINES OF DURUM WHEAT OBTAINED BY RADIO-INDUCED MUTATION. Mugnozza, Giantommaso Scarascia (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz., 14: No. 4, 37-42(Apr. 1968). (In Italian).

The Ministry of Agriculture and Forests and the Ministry of Industry are considering the documentation submitted by C.N.E.N. for the inscription in the National Durum Wheat Varieties Register and for the issuance of a patent on two lines of durum wheat (Castelporziano C.N.E.N. and Castelfusano C.N.E.N.) developed by C.N.E.N.'s Agricultural Applications Laboratory. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 33709, 33730, 33746, 33752, 33792, 33793, 33795, 33853, 33900, and 33996.

33984 (JPRS-41315, pp 44-50) NATURAL ULTRAVIOLET RADIATION AND ITS BACTERICIDAL IMPORTANCE. Belikova, V. K. Translated from pp 322-6 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966.

Observations on the bactericidal effects of ultraviolet solar radiation on the air of Moscow were made. Methods of measuring the intensity of ultraviolet solar radiation are described. Bactericidal effects were determined in terms of colonies of Escherichia coli and Staphylococcus before and after irradiation by sunlight. Cultures were sterilized as a result of the effects of direct solar rays for 30 to 45 min. Studies on window glass revealed that the glass weakened the effect of the bactericidal action of sunlight by two to three times. The virulence of a culture of mouse typhus bacteria, irradiated by sunlight at distances of 0.5 and 1.5 m from a window for a period of 1.2 and 3 hr, was considerably weakened. (H.L.W.)

33985 (NP-17428) THE EFFECT OF GAMMA IRRADIATION ON THE DEVELOPMENT OF THE FUNGI BOTRYTIS CINEREA AND RHIZOPUS NIGRICANS THAT CAUSE ROT IN STRAWBERRY FRUITS. Barkai-Golan, Rivka; Temkin-Gorodeiski, Naomi; Kahan, S. R. (National and Univ. Inst. of Agriculture, Rehovot (Israel). Volcani Inst. of Agriculture Research). Feb. 1966. 6p. (In English and Hebrew). Dep.

The effect of ^{60}Co gamma irradiation on the culture and pathogenicity of Botrytis cinerea and Rhizopus nigricans, organisms responsible for the majority of storage rots in strawberries, was investigated. Rhizopus nigricans was found to be resistant to radiation. Doses of 100 and 200 krads did not alter the development rate of the fungus in culture as compared to that of the unirradiated controls. While a dose of 300 krads did slightly reduce growth rate, formation of the sporangia was unaffected at this dose. Irradiation of B. cinerea with 100 krads did not affect the development rate in culture; however, increasing the dose to 200 krads resulted in a prolongation of the incubation period and inhibition of the growth of the inoculum in culture. Irradiation of R. nigricans inocula with 100 krads somewhat reduced the growth rate of the fungus after inoculation into the fruit. The effect became more marked when the radiation dose was increased to 200 and 300 krads. A dose of 100 krads had no inhibitory effect on the development of B. cinerea in the fruit. An increase in the dose to 200 and 300 krads resulted in a slight prolongation of the incubation period of the fungus in the fruit, i.e. 3 to 4 days instead of 2 days in the control fruit. (auth)

33986 (ORO-3347-5) PHYSIOLOGICAL STUDIES ON CLOSTRIDIUM BOTULINUM, TYPE F. Three Year Summary Report of Progress, March 1, 1965—November 30, 1967. Walls, Nancy W. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-3347. 17p. Dep. CFSTI.

Radiosensitivity, growth, toxin production, spore production and germination, and relative toxicity of toxin were investigated in different strains of Clostridium botulinum, type F. A minimum of 600,000 rads of ^{137}Cs γ radiation was required to kill 90% of a given population. Radiosensitivity was dependent upon the suspending medium used during irradiation. It was established that C. botulinum, type F, is capable of growth and toxin production at low temperatures, but toxin production was sharply reduced in cultures grown at low temperatures as compared with cultures grown in or at the optimum of 30°C. Sporulation was affected by temperature and chemical composition of the growth medium. The choice of nitrogen source and pH of the medium affected growth and toxin production. Preliminary results from studies of the effects of low doses of γ irradiation on toxin formation by spores indicate that irradiation may have a stimulatory effect upon appearance of toxin in the medium. (H.G.D.)

33987 MECHANISM OF RADIOPROTECTIVE ACTION OF TWEEN 80 ON E. COLI. Titani, Yoiti; Katsube, Yutaka (Shionogi and Co., Ltd., Osaka). Radioisotopes (Tokyo), 17: 203-7(May 1968).

Mechanisms of radioprotective action of Tween 80, the most effective radioprotector for Escherichia coli B/r in aerated condition among water soluble non-ionic surfactants, were investigated. Experimental results show that the protective effects of Tween 80 depend mostly on polyoxyethylene groups and slightly on sorbitol moiety. In the presence of 0.06 M of MEA, protective effects of Tween 80 are not additive but rather competitive. In spite of good protection for B/r, Tween 80 does not protect B_{s-1}. This strain specific property suggests the action of Tween 80 is concerned with systems rather than DNA itself. (auth)

33988 SURVIVAL OF MICRO-ORGANISMS IN SPACE. RESULTS OF GEMINI-IX-A, GEMINI-XII, AND AGENA-VIII SATELLITE-BORNE EXPOSURE AND COLLECTION EXPERIMENTS. Lorenz, Peter R. (New York State Dept. of Health, Albany); Hotchin, John; Markusen, Aletha S.; Orlob, Gert B.; Hemenway, Curtis L.; Hallgren, Douglas S. Space Life Sci., 1: 118-30 (Mar. 1968).

Dried suspensions of Penicillium roqueforti Thom, Coliphase T-1, Bacillus subtilis and tobacco mosaic virus were exposed to space on board the Gemini-IX-A and XII earth satellites and the Agena-VIII space rocket. All microorganisms tested survived the direct exposure during the Gemini-IX-A experiment. In the Gemini-XII experiment only the T-1 phage survived the direct exposure. The survival was influenced by the suspending medium and depended on the species of the microorganism. After four months of space flight on the Agena-VIII space rocket surviving fractions between 2×10^{-3} and 1.0 were found in the unopened flight container. However, micro-organisms exposed on the cover of the container during this period were completely inactivated. Shielding against solar ultraviolet radiation during flight resulted in survival of microorganisms exceeding to that of the transport controls, and the survival was considered complete. Sterile methylcellulose collection surfaces were exposed to space on board the Gemini-IX-A and XII satellites in an attempt to collect viable microorganisms in space. None of the collection surfaces yielded viable microorganisms. (auth)

33989 PHOTOBIOLOGY OF RNA BACTERIOPHAGES. II. UV-IRRADIATION OF f2: EFFECTS ON EXTRACELLULAR STAGES OF INFECTION AND ON EARLY REPLICATION. Werbin, Harold; Valentine, Raymond C.; Hildalgo-Salvatierra, Oscar; McLaren, A. D. (Univ. of California, Berkeley. Southwest Center for Advanced Studies, Dallas). Contracts AT(11-1)-34; AT(40-1)-3630. Photochem. Photobiol., 7: 253-61(Mar. 1968). (ORO-3630-3).

The effect of uv irradiation (2537 Å) on the RNA bacteriophage f2 was studied with respect to the adsorption of f2 to E. coli K12 (male strain), the penetration of f2-RNA into the host cell and the conversion of the phage nucleic acid to the double-stranded replicative intermediate. The biological parameter most sensitive to uv was the plague-forming ability of the phage. Its loss could be attributed to several factors: binding of capsid protein to phage nucleic acid interfering with host penetration by the f2-RNA; desorption of some irradiated phage at 37° from their attachment sites on the host; molecular alterations in the RNA preventing formation of the replicative intermediate within the host. The relationship of these factors to the lack of photoreactivability of irradiated f2 is discussed. (auth)

33990 KLEBSIELLA BACTERIOPHAGES. REPORT IV. RADIOBIOLOGICAL PROPERTIES. Gabrilovich, I. M.; Lukel'eva, S. I.; Anisimova, N. I. (Belorussian State Univ., Ufa, USSR). Zh. Mikrobiol., Epidemiol. Immunobiol., No. 2, 80-3(Feb. 1968). (In Russian).

A study was made of inactivation with ultraviolet and gamma rays of nine bacteriophages of Klebsiella scleromatis and one bacteriophage of Klebsiella pneumoniae. A different degree of the sensitivity of phages studied to the action of mentioned rays was determined. In comparing Klebsiella phages with those of Escherichia coli it was noted that radioresistance of the former considerably exceeded that of E. coli T-group phages. (auth)

33991 AVIAN HELPER CELL AND ITS ROLE IN THE IN VITRO TRANSFER OF ROUS VIRUS (PRAGUE STRAIN) GENOME FROM RAT TUMOUR CELLS TO CHICK CELLS. Simkovic, D.; Valentova, Nada (Cancer Research Inst., Bratislava). Folia Biol. (Prague), 14: 34-42(1968).

The virogenic rat tumor cell-line XCtc was used in mixed cultures with chick embryo fibroblasts (CEF cells) to study the in vitro transfer of Rous sarcoma virus Prague strain (P-RSV) genome from XCtc cells to CEF cells. The dose of 5,000 R of x radiation did not inactivate the viral genome of P-RSV present in the irradiated XCtc cells nor did it induce the production of infectious P-RSV by the irradiated cells. XCtc cells irradiated with the dose of 5,000 R (XCtc 5,000 R cells) were used in mixed cultures with CEF cells to study the in vitro transfer of P-RSV genome from XCtc 5,000 R cells to CEF cells. The results of fourteen individual experiments with mixed cultures showed that in the majority of experiments (in 10 out of 14 experiments) the transfer of P-RSV viral genome resulted in transformation of CEF cells into non-virus-producing cells (NP cells). Transformation of the CEF cells in mixed cultures into virus-producing cells (VP cells) occurred in the minority (in 4 out of 14) of experiments. These experiments indicated that upon transfer to the CEF cells P-RSV genome present in the XCtc 5,000 R cells behaved as a quantitatively defective virus. P-RSV viral genome was transferred in mixed cultures also from XCtc 5,000 R cells to duck embryo fibroblasts (DEF cells), the latter remaining the NP cells. The x irradiation of CEF cells with the dose of 5,000 R did not destroy their capability to interact in mixed cultures with XCtc 5,000 R cells and to accept P-RSV viral genome. CEF cells and DEF cells used in mixed cultures with virogenic XCtc cells fulfilled the role of avian helper cells. These cells were able to interact by some, for the present unknown, mechanism with XCtc cells and to integrate the transferred viral genome in producing or nonproducing form. (auth)

33992 THE RESPONSE OF SOME USTILAGINALES SPECIES TO LOW RADIATION DOSES. Savulescu, A.; Becerescu, D. Rev. Roum. Biol., Ser. Bot., 12: 219-23(1967).

Results are reported of investigations on the response of parasitic fungi belonging to the genera Ustilago and Tilletia to low radiation doses, that is to those doses that induce no genetic or lethal alterations. Doses of 1000 R x rays had a stimulating effect on teleospore germination in some species. This effect however, decreased with the dose. A significant decrease was recorded with doses of 100,000 R. Therefore, these fungi are affected by a very high radiation dose as compared to the commonly accepted threshold of radiation doses in higher plants and even in all living organisms. (Romanian Sci. Abstr.)

33993 EFFECT OF γ-IRRADIATION ON ESCHERICHIA COLI RIBOSOMES: REVERSIBLE DISSOCIATION. Tomaoki, Taiki; Miyazawa, Fumio; Nakamura, Kazunari; Scrimger, John W. (Univ. of Alberta, Edmonton). Biochim. Biophys. Acta, 157: 655-7(May 21, 1968).

Dissociation of the irradiated ribosomes resulted in 70-s, 50-s, and 30-s particles. The degree of dissociation increased with dose and time for two days. Increasing the Mg content of the medium resulted in less radioinduced dissociation and the re-formation of 70-s ribosomes. A small but significant amount of reversal was also achieved by the addition of β-mercaptoethanol. Results of tests on the effects of catalase, temperature, ethanol, and H_2O_2 treatments on radioinduced dissociation are also reported. Studies on ^{14}C-phenylaline incorporation led to the conclusion that the decrease in protein-synthesizing ability of ribosomes after irradiation may be ascribed, at least in part, to the labilization of the 70-s particles by irradiation, or to the inability of the released subunits to re-associate to form an active complex required for protein synthesis. (C.H.)

Radiosterilization and Radiopreservation

Refer also to abstract 33985.

33994 (COO-1592-25) IRRADIATION OF FRUITS AND VEGETABLES. Annual Report, April 16, 1966–April 15, 1967. Markakis, P.; Nicholas, R. C.; Schweigert, B. S. (Michigan State Univ., East Lansing. Dept. of Food Science). May 3, 1968. Contract AT(11-1)-1592. 61p. Dep. CFSTI.

Radiation at 30 Krad retarded the elongation of asparagus spears during storage without apparent deleterious effects; however, the analyses did not demonstrate a quality superiority, such as improved texture or less wastage. Irradiation of strawberries performed at the fully ripe stage for Michigan marketing practices did not confirm previous results. This season (1966) there was no increase in shelf life, in contrast to other years when 200 Krad had appreciably extended the shelf life. Perhaps the inferior quality of the berries and their high initial contamination was the cause of the poor response. A dose of 300 Krad materially increased the rate at which blueberries were subsequently freeze-dried. The market potential of this application is limited. Sweet cherries, if not heavily contaminated, keep well for four weeks so that irradiation did not improve shelf life. Radiation softening can be overcome by soaking the cherries in a $CaCl_2$ solution, preferably before irradiation. The post-harvest maturation of sweet corn was not inhibited by irradiation (40 Krad or 300 Krad). Combinations of heat (120°F, 30 min) and irradiation (150 Krad) treatment of apple juice did not give a synergistic effect on microbial destruction. However, total counts in reasonably clean juice approached pasteurization and there was some promise of improved quality. Irradiation of mushrooms at doses above 10 Krad markedly retarded the opening of the mushroom caps during storage. This effect was most promising as an application of radiation. (auth)

33995 (JEN-184-SI/I-17) CONSERVACION DE ALIMENTOS POR IRRADIACION. V. ESTUDIO ECONOMICO DEL MERCADO DE PATATAS EN ESPANA Y POSIBILIDADES DE SU CONSERVACION POR IRRADIACION. (Preservation of Food by Irradiation. V. Economic Study of the Spanish Potato Market and the Possibility of Preserving them by Irradiation). Rivas, A.; Garcia de Mateos, A.; Ortin Sune, N.; del Val Cob, M. (Junta de Energia Nuclear, Madrid (Spain)). 1967. 37p. (In Spanish). Dep.

A study of the Spanish potato market was carried out in order to know the possibilities of preservation by γ irradiation. The study was initiated with a recapitulation of statistical data on the production and consumption of potatoes by regions and seasons. Last years' losses were then estimated. In order to evaluate the monthly consumption, two ideal standard markets were established, being the price differences between the highest and lowest demand months of five arbitrary units. From these, a medium standard market is proposed. This situation would be reached when better preservation means are practiced. In this medium market the price differences would be 3. It was concluded that about 0.1×10^6 ton of potatoes could be irradiated in Spain during a period of 5.5 months. (auth)

33996 (JPRS-41315, pp 36-43) USE OF ULTRAVIOLET DISINFECTION OF THE AIR IN PHARMACIES. Zil'ber, D. A.; Olekhnovich, A. I. Translated from pp 317-21 of Ul'trafioletovoye Izlucheniya, Meditsina Publishing House, 1966.

A survey of bacterial contamination of the air of pharmacies was conducted. The tabulated results show that there was a significant amount of contamination. Devices for bactericidal radiation of the air in isolation rooms, visitors' halls, and laboratory assistants' rooms were placed in several pharmacies of Leningrad in recent years. A study of these devices revealed an inadequate level of power and improper use. In order to evaluate the devices, a study of the microflora of the air during various conditions of operation was conducted. It was found that bactericidal lamps were an effective barrier against the spread of microorganisms. Studies of the air for ozone and nitrogen peroxide were carried out during various periods of use of the bactericidal devices. It was determined that the concentrations of these substances were within the limits of permissible standards. (H.L.W.)

33997 PRESERVATION OF BREAD USING GAMMA IRRADIATION. Stehlik, G. (Reaktorzentrum, Seibersdorf, Austria). Atompraxis, 14: 195-200(Apr.-May 1968). (In German).

In this experiment attempts were made to extend the storage-life of sliced bread using γ irradiation alone and also combined with heat or chemical pretreatment. It was shown that by using combined methods to extend storage-life to 8 to 10 weeks it was possible to apply doses that are already authorized in the USA for wheat and wheat flour. The organoleptic qualities of this bread were also investigated. No difference could be noted immediately after irradiation, even at a dose of 5×10^5 rad, in comparison with the non irradiated control sample. After storing the irradiated sample for 2 months at room temperature there was naturally a deterioration in quality in comparison to fresh bread; this, however, was caused by the long storage period and not caused by the irradiation. (auth)

33998 GROWING ACCEPTANCE OF FOOD IRRADIATION. Int. At. Energy Agency Bull., 10: No. 2, 13-14(1968).

Data on food products (potatoes, onions, bacon, wheat and wheat products, dried fruits, dry food concentrates, grain, fresh fruits and vegetables, and packaged beef, pork, and poultry meats) that have been cleared for human consumption in Canada, Israel, USA, and USSR are presented in tabular form. The product, purpose of irradiation, radiation sources, the radiation dose (permissible range in Mrads) and date of approval are included. Details are based on information up to February, 1968. The words radappertization (sterilization by irradiation) and radurization (extension of market life by irradiation) are used in the table. (B.S.L.)

33999 REACTION OF ULTRA VIOLET RAY-IRRADIATED SAUSAGE WITH TBA. Matsutani, Yasuko (Sugiyama Jogakuen Univ., Japan). Eiyo To Shokuryo, 19: 351-4(Jan. 1967). (In Japanese).

The change of thiobarbituric acid (TBA) values of ultraviolet irradiated sausage was studied as an indication of changes in enzyme activity. The TBA value of ultraviolet irradiated sausage was conspicuously increased. The irradiation effect upon TBA values was limited to the surface of the sample, and no influence was observed at the inner part. Sausages covered with colored cellophane (red, yellow, and green) during irradiation, showed no effect upon TBA values. (NSA of Japan)

34000 STUDIES ON THE SPROUT-INHIBITION OF POTATOES WITH GAMMA-IRRADIATION. Park, Nou Pung; Kim, Yeun Sik; Choe, Eon Ho. J. Nucl. Sci. (Seoul), 7: No. 2, 7-12 (1967). (In Korean).

Six varieties of potatoes were γ-irradiated at 4.0 to 9.0 Krad and sprout inhibition and shriveling were observed during subsequent storage. In the high temperature storage area, the radiation effect on sprouting at 9.0 Krad was considerable; in the low temperature storage area, 7.5 Krad exerted a considerable effect. Low dose irradiation tended to promote germination and the variety of the potato affected radiosensitivity. As much as 9.0 Krad did not affect outward appearance; shriveling did not occur to a detrimental extent. (auth)

34001 STUDIES ON THE STORAGE OF SWEET POTATOES WITH GAMMA-IRRADIATION. I. Park, Nou Pung; Kim, Yeun Sik; Choe, Eon Ho. J. Nucl. Sci. (Seoul), 7: No. 2, 13-19(1967). (In Korean).

Changes in the outward appearance, weight, respiration, and composition of sweet potatoes that were irradiated with ^{60}Co γ-rays at 0.125 to 2.0 Mrad just before the time of natural sprout were observed during 3 months of storage. Just after irradiation, dark brown color of the surface skin and destruction of the tissues appeared at dosages of 1.0 Mrad and above. Through all the irradiation lots, sprouting was inhibited during the period of storage; results were best in the 0.125 Mrad irradiated lot. (auth)

34002 STUDIES ON THE STORAGE OF CHESTNUTS TREATED WITH γ-RAY. Park, Nou Pung; Kim, Yeun Sik; Choe, Eon Ho. J. Nucl. Sci. (Seoul), 7: No. 2, 1-6(1967). (In Korean).

Korean chestnuts (Dang Jin, Ha Dong) were irradiated with ^{60}Co$-\gamma$ ray at 12, 28, 45, 60 Krad after being harvested for 2 months for the purpose of inhibition of sprouting and rotting. They were stored in moist sawdust at 18 to 20°C; sprouting, rotting, respiration, and changes in any components were observed for six months. Two varieties of chestnuts showed considerable radiation effects on the rooting and sprouting inhibition though a little difference was noted between each dose. After 3 months of storage, the numbers of rotting chestnuts increased rapidly with no relation to γ-ray treatment. Respiration in the control lot increased rapidly from the time of sprouting while in the irradiated lot it increased just after the irradiation and then gradually decreased. In the control lot, reduced sugar values generally peaked about 20 February and after that decreased; it was higher in the irradiated lots than in the control lot through the whole time of storage. Reduced ascorbic acid decreased a little in the irradiated lot as compared to the control lot; the rate of decrease was considerable in the irradiated lot especially at the end of storage. (auth)

34003 EFFECT OF γ IRRADIATION ON THE MICROFLORA OF FRESHWATER FISH. III. SPOILAGE PATTERNS AND EXTENSION OF REFRIGERATED STORAGE LIFE OF YELLOW PERCH FILLETS IRRADIATED TO 0.1 AND 0.2 MEGARAD. Kazanas, N.; Emerson, J. A. (Bureau of Commercial Fisheries Tech. Lab., Ann Arbor, Mich.). Appl. Microbiol., 16: 242-7 (Feb. 1968).

Maximal shelf life was determined and microbial flora were compared for irradiated (0.1 and 0.2 Mrad) and nonirradiated yellow perch fillets stored at 1 C. Shelf life was estimated by organoleptic determinations. Microbiological studies included determination of the effects of irradiation on the total aerobic microbial population, lag phase, and rate of growth. Genera of organisms isolated from fillets through the course of microbial spoilage were identified, and the proteolytic activity of the organisms was determined. Plate counts for fish prior to irradiation showed the presence of approximately 10^6 organisms per g of sample. Irradiation to 0.1 and 0.2 Mrad produced 1.4 and 3 logarithm reductions of the initial count, respectively. Irradiation to 0.1 and 0.2 Mrad approximately doubled the product's shelf life. Organisms initially isolated from the nonirradiated fillets, in order of decreasing number, consisted of Flavobacterium, Micrococcus-Sarcina, Achromobacter-Alcaligenes-Mima, Pseudomonas, Microbacterium, Vibrio, Bacillus, Corynebacterium, Lactobacillus, Brevibacterium, and Aeromonas. By the 6th and 9th days of fillet storage, Pseudomonas and the Achromobacter group were the predominant organisms. All members of the genus Flavobacterium, but not all members of the genus Pseudomonas, were proteolytically active on raw fish juice-agar and skim milk-agar media. The Achromobacter group was found to be nonproteolytic on both media. Residual flora of fillets irradiated to 0.1 and 0.2 Mrad consisted of the Achromobacter group, Lactobacillus, Micrococcus-Sarcina, and Bacillus. Their sequence in predominance, however, varied with dose level. Not all proteolytic bacteria in the fillets were eliminated by 0.1 and 0.2 Mrad; proteolytic Micrococcus-Sarcina survived these treatments. (auth)

34004 FLIES OF CAPRI. Int. At. Energy Agency Bull., 10: 8-11(1968).

The sterile male technique campaign as directed against the Mediterranean fruit fly (*Ceratitis capitata*) in Capri is briefly described. During April to October, 1967, $\sim$50 million irradiated flies were released. It was observed that the laboratory-reared flies were able to survive in their new environment and that the fly population was drastically reduced in areas where they flourished. (B.S.L.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 33518, 33601–33603, 34767, 35726, and 35737.

34005 POWDER METALLURGY. Joyce, J. F. DMIC Rev., 4p(Feb. 21, 1968).

Developments in technologies of slip casting superalloys are summarized. Results of studies of properties of sintered ferrous parts are presented along with information on splat cooling, improved cutting tools, production of W tubing, properties of dispersion-strengthened Ni-base alloys, and properties of Co-base thoria-strengthened alloys. (J.R.D.)

34006 STUDIES ON URANIUM–MOLYBDENUM ALLOYS. Lehmann, J. Arch. Hutn., 13: 3-16(1968). (In Polish).

The metallic properties of U–Mo alloys containing from 0.5 to 3 wt % Mo were described. The structural characteristics, temperature and cyclic hot-work stability, mechanical properties, and irradiation behavior were reported. The mechanisms of the phase transformations were examined. The mechanism of the formation of the β phase from the γ matrix and of the double transformation $\beta + \gamma \rightarrow \alpha + \gamma$ is explained in order to show the process for the formation of the lamellar structure. (J.S.R.)

34007 MODERN COMPOSITE MATERIALS. Broutman, Lawrence J.; Krock, Richard H. (eds.). Addison-Wesley Series in Metallurgy and Materials. Reading, Mass., Addison-Wesley Publishing Company, 1967. 589p. $18.50.

Information on composite materials is presented in chapters on composite reinforcement, fracture of composites, strength of fibrous composites, time-dependent composite materials, properties of metal-metal and ceramic-metal fiber composites, properties of fiber-reinforced plastic composites, properties of whiskers, properties of inorganic fibers, properties of metal filaments, properties of boron filaments, glass fibers for high-strength composites, properties of shaped glass fibers, properties of fiber-reinforced plastics, properties of fiber-reinforced metals, properties of composites formed by directional solidification of eutectic alloys, properties of inorganic particulate composites, properties of dispersion-strengthened metals, and properties of inorganic filler-reinforced materials. (J.R.D.)

Corrosion and Erosion

34008 (BNL–12482) MATERIALS BEHAVIOR IN Na-COOLED REACTORS. Weeks, J. R. (Brookhaven National Lab., Upton, N. Y.). [1967]. 17p. Dep. CFSTI.

A review is presented of the physical and chemical properties of metals and alloys used in Na-cooled reactors and the effects of environment upon them. (P.G.C.)

34009 (BNWL-SA-1719) PARAMETERS WHICH INFLUENCE THE IN-REACTOR CORROSION OF ZIRCONIUM ALLOYS. Johnson, A. B. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 2, 1968. Contract AT(45-1)-1830. 14p. (CONF-680510-1). Dep. CFSTI.

From AEC Corrosion Symposium, Columbus, Ohio.

Results of tests to determine variables affecting radioinduced corrosion of Zr alloys are presented. Effects of coolant composition, alloy composition, and pretreatment procedures are emphasized. The data were obtained on samples exposed in ETR and PRTR. (J.R.D.)

34010 (DP(NASA)–1005) STRESS CORROSION CRACKING OF TITANIUM ALLOYS. Progress Report, January 1–March 31, 1965. Rideout, Sheldon P.; Louthan, McIntyre R. Jr.; Selby, Clifford L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sept. 1965. Contract AT(07-2)-1. 23p. Dep. CFSTI.

Radiographic evidence showed that ^{3}H and ^{36}Cl are retained on sample surfaces, probably as HCl, after exposure to aqueous salt solutions. Adsorption of HCl appears to be a key factor in causing susceptibility to hot-salt cracking. Exposure to anhydrous HCl gas at 650°F caused abrupt mechanical rupture in stressed samples. Exposure to liquid NaOH at 650°F caused corrosion and preferential attack of Al, but no cracking. Al is also preferentially attacked by NaCl during hot-salt cracking. Prior treatments with NaOH, which preferentially remove the Al from the sample surfaces, delayed the inception of stress cracking during subsequent exposures to solid NaCl or HCl gas. Results are interpreted to show that hot-salt cracking and HCl-gas cracking are similar and occur by either hydrogen embrittlement or by localized, stress-accelerated corrosion. (auth)

34011 (EURFNR–465) CREEP AND STRESS-RUPUPTURE PROPERTIES OF AUSTENITIC CHROME–NICKEL STEELS IN PRESENCE OF SODIUM. Hoehm, H.; Schneider, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated from report KFK–713. 11p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

A study was made on the influence of liquid sodium on the creep- and stress-rupture properties of two austenitic stainless steels at 700°C. The tests were carried out on sodium filled tubes of X8CrNiMoVNb 1613 and Incoloy 800 under uniaxial stress. It is shown that the secondary creep rate of both alloys is not influenced by sodium whereas the tertiary creep stage is shortened, resulting in a reduction of fracture strain. The time-to-rupture of Incoloy 800 alloy is decreased by the sodium. (auth)

34012 (GEAP–5530) STAINLESS STEEL FAILURE INVESTIGATION PROGRAM. Final Summary Report. Duncan, R. N. (General Electric Co., Pleasanton, Calif. Nucleonics Lab.). Feb. 1968. Contract AT(04-3)-189. 80p. (EURAEC–2023). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Experience with highly stressed austenitic stainless steel fuel rod cladding in water-cooled power reactors indicated that type-304 stainless steel and other austenitic alloys were susceptible to stress-assisted intergranular corrosion attack even though there were no carbide precipitates in the grain boundaries. Experimental work pertinent to this experience is reported. Corrosion testing of high-purity austenitic alloys with controlled impurity additions in $HNO_3 + Cr^{6+}$ and in 650°F dilute iron chloride solutions indicated that C, Si, and P are of major importance in determining the intergranular corrosion resistance of austenitic alloys. C additions affect the intergranular corrosion resistance but are dependent on heat treatment before testing. Mn, S, Ni, and O had very little effect in either test media. Techniques used to explore differences between grains and grain boundaries in austenitic stainless steels include grain boundary microhardness measurements, and grain boundary polarization measurements. The microhardness and polarization experiments demonstrated differences between grains and grain boundaries in austenitic stainless steels containing selected impurities. A model was developed which describes the effects of variables on the intergranular corrosion susceptibility of nonsensitized austenitic stainless steels. The model is based on the phenomenon of equilibrium solute segregation at grain boundaries and suggests that elemental impurities are segregated at grain boundaries in commercial austenitic stainless steels. Intergranular corrosion susceptibility of austenitic stainless steels is strongly influenced by the concentration of selected impurities rather than by variations in the Cr and Ni contents (alloys with nominal Cr–Ni% contents of 18-8, 16-12, and 20-30 were tested). Stresses and strains which existed in the type-304 stainless steel cladding during fuel rod operation were estimated. Metallographic examination results demonstrated that in regions where the local surface strains exceeded 0.006 in./in., partial intergranular cracks were found. This indicated that stresses (strains) are a prerequisite for intergranular attack in unsensitized type-304 stainless steel cladding. (auth)

34013 (IITRI–578-P-29-23) RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT. Period Covered: January 1, 1968–March 31, 1968. (IIT Research Inst., Chicago, Ill.). Apr. 16, 1968. Contract AT(11-1)-578. 31p. (EURAEC–2015). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The initial 448 tubular brazed samples received from IIT Research Institute were tested for 1 week in the hot loop. During this test, problems were experienced in controlling the chloride content of the coolant. In addition, excessive suspended solids were picked up by the loop filters. The test was halted after 1 week and the specimens removed from the loop for examination. Excessive wear and fretting were observed on 47 specimens. These were the cause of the high suspended solids. A new specimen holder was designed to eliminate the fretting by individually clamping each specimen rather than stacking and spring loading the specimens. The problem of controlling the chloride content of the coolant was found to be associated with release of chlorides by the Type I anion resins used in the demineralizer. The resin has been changed to a Type II anion resin which tests show will eliminate the problem. (auth)

34014 PROCESS FOR THE PROTECTION OF METALS. Armand, Marcel; Charveriat, Michel; Salmon, Michel (to Societe d'Electro-Chimie, d'Electro-Metallurgie et des Aciers Electriques d'Ugine). British Patent 1,111,983. May 1, 1968. Priority date Aug. 30, 1965, France.

A description is given of methods of protecting Zr, Ti, Hf, Nb, Ta, V and their alloys against penetration by interstitial elements using deposition of an Al–Si–Me coating of the metal to be protected on its surface. The coating is deposited by immersing the part in a high-temperature liquid bath consisting of Al, Si, and a quantity of the same metal as that to be protected. (J.R.D.)

34015 METHOD OF PROTECTING MAGNESIUM OR ITS ALLOYS FROM CORROSION IN ORGANIC LIQUIDS. De Beni, Gianfranco (to EURATOM). British Patent 1,113,572. May 15, 1968. Priority date Jan. 20, 1965, Belgium.

Corrosion in a nuclear reactor of the ORGEL type, which employs Mg or an Mg alloy in contact with an organic coolant or moderator liquid, is inhibited by adding NH_4OH and CO_2 to the liquid. Alternate specifications include addition of biphenyl or substances which produce NH_4OH and/or CO_2 under operating conditions. (P.G.C.)

Preparation and Fabrication

34016 (GEAP–5589) THE FABRICATION AND CHARACTERIZATION OF Zr–Cr ALLOY TUBING. Busboom, H. J.; Cleveland, G. W.; Klepfer, H. H.; Shannon, H. L. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Feb. 1968. Contract AT(04-3)-189. 43p. (EURAEC–2012). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

A Zr + 1.5 wt % Cr + 0.08 wt % Fe alloy (designated Zr-Cr) has been developed with the potential for improved service reliability as boiling water reactor fuel cladding. The fabrication of significant quantities of fuel cladding tubing and bar stock from a large ingot of Zr-Cr alloy is described. Characterization tests on these wrought products confirmed the excellent high purity water corrosion resistance for this composition at temperatures above 300°C. Mechanical properties were equal to present Zircaloy-2 fuel cladding tubing. Also described is an irradiation test program where the performance of Zr-Cr alloy clad fuel rods is being compared directly with similar Zircaloy-2 clad fuel rods in a boiling water power reactor environment. Included in this experiment are nonfueled dummy rods to separate the effects of heat transfer during irradiation on the corrosion of the Zr-Cr alloy. (auth)

34017 (ORNL-TM–2215) EFFECT OF POWDER AND PROCESS VARIABLES ON THE PROPERTIES OF SINTERED ALUMINUM PRODUCTS. Copeland, G. L.; Martin, M. M.; Harman, D. G.; Martin, W. R. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 58p. (CONF-680509–1). Dep. CFSTI.

From International Conference on Powder Technology, Chicago, Ill.

A fabrication process for SAP billets is reported. Upon subsequent extrusion this material has uniform properties with strength greater than commercial SAP with equivalent oxide concentration. The optimum method of introducing the Al_2O_3 dispersoid is ball-milling atomized Al powder to flake shape with stearic acid as a surfactant. The optimum route for producing an extrusion billet is vacuum hot pressing of the milled powder followed by vacuum heat treatment of the billet immediately before extrusion. The heat treatment converts the low-temperature hydrates of alumina to a mixture of eta and chi forms of Al_2O_3, which behave stably at the expected service temperature of SAP. Removal of water and hydrogen before extrusion is necessary for thermal stability of the alloy. Inclusions of Fe up to 3 wt % and C up to 2 wt % in the form of Al_4C_3 had no significant effect on the mechanical properties of extruded rods. (auth)

34018 (Y-DA–1730) SPARK DISCHARGE MACHINING METHOD FOR PREPARING URANIUM ALLOY SPECIMENS FOR X-RAY ANALYSIS. Wiedemann, C. M. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 21, 1967. Contract W-7405-eng-26. 14p. Dep. CFSTI.

Spark-discharge machining methods were applied in making small (0.1 inch by 0.1 inch by 1 inch) specimens for Debye–Scherrer x-ray analysis of the effect of varying quenching rates on U alloys. A spark machine and an accessory rotating chuck was used to point the specimens. Afterwards, an electropolish was used to remove the damaged surface layer. The method is fast, produces quality specimens, and requires a minimum of operator skill. (auth)

34019 BERYLLIUM. Hanes, H. D.; Zurey, F. T. DMIC Rev., 5p.(June 19, 1968).

A study of the feasibility of producing fine, stable dispersions of tungsten and thoria in beryllium is described. The mechanisms of crack initiation in wrought polycrystalline beryllium obtained from both the powder and cast processes are outlined. Beryllium fabrication processes, e.g., vapor deposition, forging, and rolling, are reviewed. A metallographic technique for electrolytic polishing and etching of beryllium is briefly discussed. (R.C.K.)

34020 POWDER METALLURGY. Joyce, J. F. DMIC Rev., 4p.(June 21, 1968).

Recent developments in powder metallurgy are summarized. Forging and slip casting of superalloys are discussed. Recent work on the extrusion of superalloy powders is outlined. The development of oxide dispersion-strengthened superalloys is described. (R.C.K.)

34021 PREPARATION OF SCANDIUM METAL. Pullman, B. J. (Australian Mineral Development Labs., Adelaide). Australas. Inst. Mining Met. Proc., No. 2, 141-4(1967).

From Symposium on Research in Chemical and Extraction Metallurgy, Sydney. See CONF-650225.

The procedure investigated at AMDEL for the preparation of scandium metal involves reduction of scandium chloride with an alkali metal. This method has in part been used previously but the reaction products were not separated. Scandium chloride, prepared by chlorination at 1000°C of the oxide mixed with the stoichiometric quantity of carbon, was reduced with potassium at very moderate temperature (250°C) in an atmosphere of argon in two stages. The metal powder produced was compacted and transferred to an arc melting furnace. Melting was accomplished in an argon atmosphere giving a button of scandium for oxygen. Two methods of purification were examined, the first involving the distillation of scandium subchloride and disproportionation, the second method being conventional vacuum sublimation. (auth)

34022 TRENDS IN THE DEVELOPMENT OF POWDER METALLURGY. Missol, Witold; Cegielski, Waclaw. Rudy Metale Niezelaz., 13: 77-81(Feb. 1968). (In Polish).

The development of powder metallurgy is discussed with particular consideration of metal powder production and shaping. Progress in the manufacture of sintered structural parts, bearings, frictional materials, magnetic materials, intermetallic compounds, high melting metals, dispersion-strengthened materials, nuclear materials, and materials for special purposes is reported. Important advances made in fundamental research are discussed and directions of development in different fields of powder metallurgy are indicated. (tr-auth)

34023 TUNGSTEN NEWS, JUNE 1968. New York, Climax Molybdenum Co., 1968. 16p.

Recent developments in vapor deposition of tungsten metal are outlined. The development of tungsten carbides with improved physical properties is reviewed. The use of tungsten as an alloying element in superalloys and tool steels is discussed. The properties of tungsten compounds (other than carbides) are given. A bibliography consisting of 161 references on tungsten metal and compounds is presented. (R.C.K.)

34024 REFINING TUNGSTEN AND MOLYBDENUM BY SINTERING. Sabin, A. V.; Smirnov, N. D.; Alekseev, V. I. Tsvetn. Metal., No. 3, 85-7(Mar. 1968). (In Russian).

A thermodynamic analysis was made of the process of W and Mo refining by sintering in a vacuum and in hydrogen. In agreement with calculations, practically complete decarbonization and reduction of the refractory metals was attained during sintering in equilibrium conditions. The content of oxygen and carbon showed the large effect of the active metallic admixtures and the kinetics of the sintering process. (tr-auth)

34025 TEKHNOLOGIYA PROIZVODSTVA NIOBIYA I YEGO SPLAVOV. (Technology of the Production of Niobium and its Alloys). Mal'tsev, Mikhail Vasil'evich; Baikov, Aleksei Ivanovich; Solov'ev, Valentin Yakovlevich. Moscow, Izdatel'stvo Metallurgiya, 1966. 291p.

The physical, chemical, and mechanical properties of Nb and Nb-base alloys are reviewed. Problems of producing Nb and Nb-alloy semifinished and finished products are discussed and the principal fields of their use are indicated. (ATD)

34026 OBRABOTKA REZANIYEM TUGOPLAVKIKH SPLAVOV NA OSNOVE MOLIBDENA. (Machining of Refractory Molybdenum-Base Alloys). Zorev, Nikolai Nikolaevich; Fetisova, Zinaida Mikhailovna. Moscow, Izdatel'stvo Mashinostroyeniye, 1966. 224p.

Specific characteristics of the process of machining refractory of Mo alloys are discussed and a systematic description of patterns in the effect of cutting conditions on the basic characteristics of the cutting process is given. Practical recommendations on selecting efficient cutting conditions for turning, milling, boring, reaming, thread cutting, and grinding operations are offered. The analysis includes new concepts of machining, namely the role of adhesion and chemical wear of the tool, the effect of cutting conditions on the tool hardness, the effect of the material on tools made of hard alloys, and high-speed steels. (ATD)

34027 NEW BRAZING TECHNIQUES EXTEND BERYLLIUM'S APPLICATION RANGE. Prod. Eng., 39: 84-5(Jan. 1, 1968).

New techniques in brazing Be for structural members for aerospace applications are reviewed. Subjects discussed are physical properties of Be, surface preparation, elimination of impurities, crystal structure, brazing alloys, and the brazing process. (P.G.C.)

34028 APPLICATION OF HOT PRESSING FOR MANUFACTURE OF ROUND PROFILES FROM HARD ALLOYS. Dzugutov, M. Ya.; Vinogradov, Yu. V.; Golovanenko, S. A.; Chernov, A. N. Kuznechno-Shtampovochnoe Proizvod, No. 7, 4-7(July 1967). (In Russian).

Experimental work is reported on extrusion of four types of hard Ni-base alloys containing Cr, Mo, Ti, Co, and Al additions. The starting billets (cast or forged) are heated at 1120 to 1200°C in a BaCl bath, or by induction, and extruded into rods (24 to 60 mm dia) on a 1500-ton hydraulic press using a die with internal bevel angle of 120°. Glass wool and glass powder (of various viscosity) were used for lubrication. On the basis of experiments the optimum parameters were selected for extrusion temperature, extrusion deformation, deformation rate and lubricants. Data are given on critical deformations at which the surface of rods becomes crack susceptible and also data on tensile and creep strength of rods at 700 to 900°C. (Rev. Metal Lit.)

34029 PRESSING OF MOLYBDENUM TUBES. Korolev, V. N.; Galakhov, A. I. Kuznechno-Shtampovochnoe Proizvod, No. 7, 22-6(July 1967). (In Russian).

Experiments are reported on hot pressing of Mo tubes, used in vacuum electronics, from tubular blanks made by powder metallurgy. Pressing was done in conical or spherical dies at 220 to 240°C using graphite lubrication. Prior to hot pressing, as well as after each pressing pass, the billets were annealed in H_2 or in vacuum. Recommendations are made on optimum deformations per pass and optimum deformation rates at which the billet does not loose its stability. (Rev. Metal Lit.)

34030 PLATING ON DIFFICULT-TO-PLATE MATERIALS. Friedman, I. Plating, 54: 1035-8(Sept. 1967).

Commercially practical processing sequences that provide for reliable service by components and related hardware so plated are discussed. Those metals and alloys used by the electronics industries are discussed which are considered unusual, (difficult to clean and prepare to the point of application of a sound, adherent and functionally acceptable deposit). The materials outlined are Al alloys, Cu alloys, Mo, glass-to-metal sealing alloys, Nb, Ni alloys, high-carbon steels, and Ti. (Rev. Metal Lit.)

34031 IMPROVEMENTS IN OR RELATING TO METHODS OF AND DEVICES FOR PURIFYING HIGH MELTING-POINT METALS. (to Societe Anonyme Heurtey). British Patent 1,115,092. May 22, 1968. Priority date Nov. 17, 1964, France.

Purification of high-melting point metals of groups IVa, Va, and VIa of the periodic system is accomplished in an electron beam furnace by addition of purification agents such as C, Si, Al, metal carbides, silicides, or aluminides to the melt, if the impurity is O_2, or an oxide of the metal if the impurity to be removed is C or Si. Temperatures specified are in the range of 2000 to 4000°C. (P.G.C.)

34032 ULTRASONICS MAKES BIG IMPACT ON TUBE DRAWING. Metalwork. Prod., 111: 50-1(Aug. 9, 1967).

Application of high-frequency ultrasonic energy to a fixed mandrel during tube drawing can increase production by 35%, increase tool life because of reduced friction and reduce the total draw force by 5 to 10%. Stainless steel, Ni alloys, beryllium copper, brass, Cu, Al, Ti, Zr, and palladium silver have been drawn to date, in diameters up to 1.5 in. OD. (Rev. Metal. Lit.)

Properties Evaluations

Refer also to abstracts 33530, 33618, 34067, 35461, 35534, and 35686.

34033 (BARC-306) EFFECT OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF Zr-1 PERCENT Cr, Zr-0.5 PERCENT Nb- AND Zr-0.5 PERCENT Nb-1 PERCENT Cr ALLOYS. Ray, S.; Mehta, M. L. (Bhabha Atomic Research Centre, Bombay (India)). 1967. 24p. Dep.

The effects of heat-treatment on the mechanical properties of Zr-0.5 wt % Nb, Zr-1.0 wt % Cr, and Zr-0.5 wt % Nb-1.0 wt % Cr alloys are reported. The ternary Zr-0.5 wt % Nb-1.0 wt % Cr alloy shows much higher strength as compared with Zr-0.5 wt % Nb or Zr-1.0 wt % Cr alloy, on quenching from 900°C. A study of the mechanical properties of the binary alloys further reveals that Cr is mainly responsible for the higher strength of the ternary alloy whereas Nb seems to be effective in bringing about better work-hardening characteristics in it. The ternary alloy, on quenching from 900°C, undergoes martensitic transformation and is stable up to 500°C tempering temperature. Tempering at higher temperatures causes precipitation of Cr as $ZrCr_2$ with an appreciable drop in strength. (auth)

34034 (BBC-TR-242) BERYLLIUM BASE ALLOYS. Beaver, Wallace W. (Brush Beryllium Co., Cleveland, Ohio). [nd]. Contract AT(30-1)-541. 42p. (CONF-693-2). Dep. CFSTI.

From Conference on the Metallurgy of Beryllium, London, Oct. 1961.

A review of unpublished research on the characterization of Be alloys is presented. Information is included on dispersed phase hardening and ductile matrix alloys and on high-temperature intermetallic compounds. (J.R.D.)

34035 (BNL-12439) EFFECT OF MICROSTRUCTURE ON THE ELEVATED TEMPERATURE DUCTILITY OF IRRADIATED AUSTENITIC STAINLESS STEELS. Chow, J. G. Y. (Brookhaven National Lab., Upton, N. Y.). [1967]. 13p. (CONF-680604-1). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

Deformation of 304 stainless steel to 18% at 77°K, annealing at 705°C, deforming again to 18% at 77°K and annealing at 760°C for 16 hr developed a fine grained structure, with a fine precipitate of carbides, and elimination of the original austenitic grain boundaries. After irradiation to a fluence of 1.3×10^{20} the elevated temperature strength was lower but ductility increased. Fracture was predominantly intergranular. (P.G.C.)

34036 (BNL-50107) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 6, Number 1. (Brookhaven National Lab., Upton, N. Y.). Feb. 1968. 48p. Dep. CFSTI.

A review of current information on various research and development programs in the U. S. in the field of high-temperature liquid-metal technology is presented. Subjects reviewed include thermodynamics and physical properties, fluid dynamics, erosion, corrosion, materials development, instrumentation, chemistry, chemical analysis, systems studies, fabrication techniques, and safety. References are listed for each phase of research. (P.G.C.)

34037 (BNWL-SA-1458) IN-REACTOR CREEP OF STRUCTURAL MATERIALS FOR NUCLEAR APPLICATIONS. Gilbert, E. R.; Harding, N. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 20, 1968. Contract AT(45-1)-1830. 34p. (CONF-680604-5). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

Neutron irradiation can cause the creep rate of a material to increase, decrease, or to remain unchanged. Each of these possible results has been observed in creep during neutron irradiation. In hcp alloys increased creep rates have been observed both in Zircaloy-2 and Zr-2.5 Nb at creep rates below 10^{-10} sec^{-1} at 300°C. At temperatures above 350°C in-reactor creep rates of Zr-2.5 Nb are not different than those of unirradiated control tests, whereas in Zircaloy-2 the creep rate may increase, decrease, or remain the same upon reactor shutdown depending on the stress and temperature. Stress relaxation tests reported for zirconium alloys below 100°C resulted in more relaxation during neutron irradiation inferring faster creep rates. In-reactor creep tests for fcc alloys type 304 stainless steel and Hastelloy X-280 at temperatures above 500°C have resulted in little if any difference in creep rate, although the range of second stage creep was significantly reduced. Faster in-reactor creep rates are inferred for nickel, copper, and 18-8 stainless steel through greater stress relaxation during neutron irradiation below 100°C. Effects of neutron irradiation on the creep of bcc metals have been demonstrated in post-irradiation creep tests of molybdenum which for specific conditions of exposure, temperature and stress, much faster creep rates were observed. Stress relaxation of alpha iron at temperatures below 100°C was greater during neutron irradiation thus inferring faster creep rates. (auth)

34038 (BNWL-SA-1805) THE EFFECT OF COLD WORK, THERMAL TREATMENT, AND NEUTRON IRRADIATION ON THE FRACTURE TOUGHNESS OF ZIRCALOY-2. Rowe, R. G.; Hoagland, R. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 26, 1968. Contract AT(45-1)-1830. 25p. (CONF-680604-4). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

The temperature dependence of fracture behavior of Zircaloy-2, as affected by cold working, hot water environment, and neutron irradiation is discussed. (P.G.C.)

34039 (GEAP-5603) SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. Quarterly Progress Report Nos. 18 and 19. Duncan, R. N.; Klepfer, H. H.; Pickett, E. A.; Blood, R. E.; Rieger, G. F. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Jan. 1968. Contract AT(04-3)-189. 40p. (EURAEC-2018). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A Zr + 2.0 at. % Cr + 0.16 at. % Fe alloy (Zr−Cr) is being evaluated as nuclear fuel cladding. Zr−Cr alloy-clad fuel rods are being irradiated in the Big Rock Point reactor to a target exposure of 15,000 to 20,000 MWd/t. The rate of fuel burnup has been approximately 800 MWd/tU (average) per month of full-power operation. The Zr−Cr alloy-clad fuel rods have accumulated a total of approximately 6000 MWd/tU average exposure as of January 31, 1968. This corresponds to about 5100 hours of high-temperature, full-power, reactor operation. The long-term, out-of-pile, loop corrosion tests are continuing satisfactorily. Zr−Cr alloy samples are being tested in the loop under heat transfer conditions, and have accumulated about 3800 hours exposure as of January 17, 1968. Mechanical test results, burst and tensile tests, indicate that the fine-grain Zr−Cr tube material is stronger and less ductile than the usual Zircaloy-2 tubing; however, the high-temperature stress rupture performance of the fine-grain size Zr−Cr is poorer than that of the Zircaloy-2 materials. (auth)

34040 (GEPP-35) DUCTILITY AND FORMABILITY OF FOUR VARIETIES OF MOLYBDENUM SHEET. Mallett, M. W. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). May 17, 1968. Contract AT(29-2)-656. 19p. (R-68-ND-12). Dep. CFSTI.

Powder metallurgy process Mo sheet from two manufacturers (Varieties A and B), a low alloy Mo sheet (Variety C) and an arc vacuum cast Mo sheet (Variety D) are evaluated for ductility and formability characteristics. Bend, Olsen cup, hardness, and tensile testing results, supplemented by weld bead tensile tests and metallographic studies, are given for all four varieties of Mo. Test results show that Variety C, a low alloy Mo, is about equal in formability to Variety A powder metallurgy sheet. Both Variety A and C sheets are superior in ductility and formability when compared with the other varieties of Mo tested. (auth)

34041 (LA-3909) PERMEATION AND DIFFUSION OF NITROGEN, OXYGEN, AND RARE GASES THROUGH STAINLESS STEEL: A BIBLIOGRAPHY. Furnish, Jean (comp.) (Los Alamos Scientific Lab., N. Mex.). Jan. 1968. Contract W-7405-eng-36. 5p. Dep. CFSTI.

Twenty-four references are listed covering articles and reports published from 1947 to 1967. Phases itemized include permeability of tubes, behavior of nitrided steels, intergranular oxidation in 310 stainless steel, degassing, bimetallic systems, permeability of stainless and mild steel to Ar and He, and apparatus for studying diffusion of gaseous fission products in stainless steel. (P.G.C.)

34042 (MLM-1453) THICK ADHERENT METAL COATINGS BY MEANS OF TWO CATHODES IN A GLOW DISCHARGE. Wood, T. W. (Mound Lab., Miamisburg, Ohio). Aug. 1966. Contract AT(33-1)-Gen-53. 27p. Dep. CFSTI.

Adherent metal coatings up to 0.40 mm thick were deposited onto metal substrates by means of two cathodes in a glow discharge. The samples to be coated were mounted on one of the cathodes. These samples were cleaned before and also during deposition by ion bombardment sputtering. The other cathode contained the coating material in a tray. The tray was thermally insulated from its supports. Thus the tray and contents could be heated so that the coating material evaporated. The initial layers of the coating may be deposited by bias sputtering; however the bulk of the coating was deposited at rates up to 0.015 mm/min when the coating material evaporated. The method may be defined as evaporation-abetted bias sputtering. The physical processes involved were those of ion plating and bias sputtering. Coatings deposited by this method at a 400°C sample temperature adhered very well; coatings deposited at 100°C adhered only moderately well, however, primarily due to low coating ductility at the 100°C deposition temperature. With conventional ion plating equipment, cathode temperature is limited to about 1200°C. Thus silver and more volatile metals can be deposited. (auth)

34043 (MLM-1458) TAP DENSITY VALUES FROM IRREGULAR BORON PARTICLES. Voigt, J. W. (Mound Lab., Miamisburg, Ohio). June 7, 1967. Contract AT-33-1-GEN-53. 16p. Dep. CFSTI.

A study was made of the packing characteristics for irregular shaped particles of crystalline boron ranging between the limits of 20 to 105 μ. The material was divided into seven size groups ranging in magnitude from 8 to 17 μ. These groups were checked first through a series of similar tests to determine the rate of packing and the apparent maximum density. The study includes an investigation of the possible effects on tap density values when different parent pellets were used. The study also covers the effects of sample quantity on the apparent maximum tap density and includes the results from varying the mixture of two size groups over a range of percentage composition. The study generally revealed many of the same packing characteristics as those found for spheres; the maximum density values were several percentage points lower and seemed to vary with particle size. The density values seemed to fluctuate within a narrow range instead of packing to consistently repeated values. (auth)

34044 (TID-24491, pp 57-64) EQUILIBRIUM MODEL OF THE REACTION OF A GAS WITH A SOLID TO FORM VOLATILE PRODUCTS: STEADY-STATE OXIDATION OF TUNGSTEN. Batty, J. C.; Stickney, R. E. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The model is briefly described, and then applied to the oxygen-tungsten system. (M.O.W.)

34045 (WAPD-Trans-90) ABNORMAL PHENOMENA DURING STRESS RELAXATION IN BERYLLIUM BRONZE. Grachev, S. V.; Zubov, V. Ia. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Izv. Vyssh. Ucheb. Zaved. Tsvet. Met., 10: No. 2, 121-3(1967). 6p. Dep. CFSTI.

This report was abstracted from the original language and appeared in NSA as 22: 6988. (R.C.K.)

34046 (WARD-3791-17) VANADIUM CLADDING ALLOY DEVELOPMENT. Quarterly Progress Report for the Period Ending March 31, 1968. Bishop, E. C.; Nadler, R. A.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). May 1968. Contract AT(30-1)-3791. 66p. Dep. CFSTI.

Physics calculations have shown that the sodium void coefficient of reactivity was 8 percent more favorable for 0.010-inch-thick V−Cr−Fe−Zr−C alloy (VANSTAR-7) than for 0.014-inch-thick type 316 stainless steel. The Doppler coefficient of reactivity, which was nearly independent of cladding thickness, was 10 percent more favorable for the V−Cr−Fe−Zr−C alloy (VANSTAR-7) than for type 316 stainless steel. The breeding ratios at beginning of life and end of life were nearly the same for both vanadium alloys and type 316 stainless steel. Assuming a $4.00/ft tubing cost for vanadium, the fuel cycle cost was about 0.10 mills/kWh higher with vanadium cladding than with type 316 stainless steel at $1.20/ft. Preliminary estimates indicate that, if the core operating temperature is increased by 55°C in the vanadium design and the fuel pellet diameter is increased in both the vanadium and the reference designs, plant equipment and fuel cycle costs for the vanadium design will be at a break-even point with type 316 stainless steel. All the vanadium raw material has been received and one ingot of each of the five alloys has been produced. Specimens were produced from VANSTAR-8, VANSTAR-9, and the V-20 Ti alloys. Preliminary creep tests indicate that VANSTAR-9 is extremely creep resistant at 700 and 800°C, but that test atmosphere purity may have a very significant effect on creep properties. Studies of the recrystallization and aging behavior of the VANSTAR alloys were initiated. Construction of both sodium corrosion loop systems was completed. The compatibility program was replanned to include unmodified carbide fuel in the evaluation. The irradiation programs were detailed. (J.C.W.)

34047 EFFECT OF EMANATION OF THORIUM ORES ON RADIOMETRIC MEASUREMENTS. Novikov, G. F. Zap. Leningrad. Gorn. Inst., 51: 114-24(1966). (In Russian).

The effects of radiation due to emanation under conditions where radiometric analyses are carried out on powder samples or in radiometric sampling of thorium ores in place are calculated. Results of observations of the effects of the increase in β- and γ-radiation due to emanation in hermetically sealed powder samples and surface outcrops of ore, and of the effects of contamination of the walls of a drill hole by the decay products of thoron are included. (Geophys. Abstr.)

34048 POWDER METALLURGY. Joyce, J. F. DMIC Rev., 3p(Oct. 20, 1967).

An atomization process for producing superalloy powders is reported. Yields of −40-mesh Udimet 700 and B-1900 powders were greater than 70% and the O_2 contents of the powders was substantially below the 300 ppM objective. Powder metallurgy tungsten billets, both with and without Mo cladding, were reduced 12 : 1 by extrusion at 2400 to 4000°F. With cladding, extrusion was possible with preheat temperatures as low as 2400°F. Unclad billets could not be extruded with preheat temperatures less than 2800°F. An ultrasonic evaluation of the yield and tensile strengths of sintered steel powder compacts is reported. Results for 4630 and 4650 steel powder tensile bars are shown. A method has been developed for fabricating very low-density tungsten ionizers. The method uses very fine powders of H_2-reduced tungsten, copper and boron nitrides. Work to develop new tool materials capable of machining high-strength and thermal-resistant alloys is continuing. (J.C.W.)

34049 CONDUCTOMETRIC IMPURITY INDICATOR IN LIQUID-METAL COOLANTS. **Ivanovskii, M. N.; Arnol'dov, M. N.; Shmatko, B. A.; Pleshivtsev, A. D.; Korotaev, S. K. At. Energ. (USSR), 24: 392-4(1968). (In Russian).**

Apparatus used to determine the resistance of circulating NaK coolant, in order to calculate the impurities requires a complex circuitry; in addition, it is difficult to compensate for temperature-induced resistivity changes. An improved double, dc bridge was therefore designed, determining the ratio of the resistivities of the unknown specimen and of a reference sample. In order to eliminate the effect of parasitic emf, the measurements were carried out in both directions. The device was tested in a circulating-NaK test stand, provided with a purification system. The results indicated that at 350°C the resistivity of the liquid metal is quite sensitive with respect to oxygen content and is practically independent of the hydrogen concentration. The sensitivity of the device was 3.3×10^{-5} wt % per division. Tests carried out with circulating 350 to 500°C loops revealed that linearity is preserved even under nonisothermal conditions. (TTT)

34050 CONTINUOUS COMPILATION OF NEW REFERENCE DATA ON DIFFUSION PROCESSES IN INORGANIC SOLIDS AND THEIR MELTS. **Diffus. Data, 2: No. 1, 1-102(Apr. 1968).**

A compilation of new reference data on diffusion processes in organic solids and their melts is presented. The temperature and pressure ranges over which the data are applicable are given, as well as information on the experimental methods employed for their determination and on the purity and properties of the materials. Lists of references, institutions, and an author index are included. (R.C.K.)

34051 SOME PROPERTIES OF CHROMIUM–TUNGSTEN STEELS. **Colombier, L.; Leveque, R. Mem. Sci. Rev. Met., 65: 229-40(Mar. 1968). (In French).**

The structural developments of Cr-W steels during tempering are summarized. Residual austenite begins to become unstable on heating above 550°C. On cooling it is transformed first into martensite and then into bainite. When heated above 600°C, it is transformed isothermally into fine globular pearlite. (auth)

34052 CONTRIBUTION TO THE STUDY OF THE TENSILE DEFORMATION OF ZIRCONIUM AND TITANIUM. **Brehm, C.; Lehr, P. Mem. Sci. Rev. Met., 65: 275-81(Mar. 1968). (In French).**

Measurement, at liquid hydrogen temperature, of the residual resistivity resulting from tensile deformation at room temperature was made. The increase in resistivity, as well as the dislocation density, is a linear function of true elongation. (tr-auth)

34053 TENSILE PROPERTIES OF GAMMA QUENCHED AND AGED URANIUM-BASE NIOBIUM ALLOYS. **Jackson, Ross J.; Miley, Delmar V. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Amer. Soc. Metals, Trans. Quart., 61: 336-43(June 1968).**

Tensile test data are presented for uranium-base niobium alloys containing 11, 15, 17, and 19 at. % Nb in the gamma quenched and gamma quenched and aged conditions. The tensile test data are correlated with metallographic and x-ray studies. These alloys, although martensitically formed, supersaturated solid solutions, are weakest in the as-quenched condition. Aging the alloys for 1-hr periods at temperatures below 300°C results in a noticeable increase in strength with no loss in supersaturation. The data are interpreted in terms of plastic deformation occurring by the motion of twin interfaces and in the pinning of twin interfaces on aging. A wide variety of mechanical properties are available from these heat treatable and corrosion-resistant alloys, and they show promise as an economic, high-density, engineering material in both nuclear and non-nuclear applications. (auth)

34054 MECHANICAL PROPERTIES OF MOLYBDENUM AFTER HYDROEXTRUSION. **Mochalov, G. A.; Martynov, E. D.; Beresnev, B. I.; Evstyukhin, A. I.; Rodionov, K. P.; Bulychev, D. K.; Ryabinin, Yu. N. (Moscow Engineering Physics Inst.). Fiz. Metal. Metalloved., 25: 357-60(Apr. 1968). (In Russian).**

The effects of hydroextrusion on the mechanical properties of different sorts of Mo were investigated. It was shown that with increase of the deformation during hydroextrusion the stability characteristics and the toughness of the material is noticeably increased, whereas the plasticity of the same material can be different. (tr-auth)

34055 DIFFUSION OF SULFUR IN MOLYBDENUM. **Bandyshev, B. A.; Panov, A. S. Fiz. Metal. Metalloved., 25: 321-5(Feb. 1968). (In Russian).**

The diffusion of S into monocrystalline Mo was studied at 2220 to 2470°K by means of the radioisotope ^{35}S. By means of autoradiography of the samples after diffusion annealing, the distribution of S in the monocrystalline Mo was determined. A possible mechanism of the diffusion was considered on the basis of a comparison of experimental and calculated values of the activation energy and preexponential multiplier. (tr-auth)

34056 CHARACTERISTICS OF TANTALUM ELASTICITY AT 20 TO 1800°C. **Nadezhdin, G. M.; Kashtalyan, Yu. O.; Gavrilyuk, M. I. Dopov. Akad. Nauk Ukr. RSR, Ser. A, No. 4, 350-2(1968). (In Russian).**

The characteristics of elasticity (E, G, μ) are determined for tantalum electron-beam heated at 20 to 1800°C. These temperatures are considerably higher than those at which these characteristics have been determined up to the present. It is established that both at normal and high temperatures tantalum containing oxygen has Young's modulus higher than the pure metal under analogous conditions. (auth)

34057 WELDING BY ELECTRON BOMBARDMENT: APPLICATIONS TO THE WELDING OF URANIUM ALLOYS. **Boncoeur, M. Met. Spec., 1: No. 2, 41-50(1968). (In French).**

The principles of electron beam welding are reviewed, and the various types of guns for welding are described. The techniques for formation of deep welds are given. The parameters which modify the form and dimensions of the welds are outlined. The application of the electron beam welding to the welding of U–Cr–Si–Zr alloys and to U alloys with 10% Mo is described. (J.S.R.)

34058 FRACTURING BEHAVIOUR AND SIZE EFFECT OF SPECIMEN WIDTH ON THE TRANSITION BEHAVIOUR IN VARIOUS CHARPY TEST SPECIMENS. **Kobayashi, Toshiro; Takai, Koichi; Maniwa, Hideyo (Fjui Electric Co., Ltd., Yokosuka, Japan). Nippon Kinzoku Gakkaishi, 32: 213-17(1968). (In Japanese).**

By sectioning Charpy specimens with various types of notches from Mn–Mo steel for reactor pressure vessels and recording the relationship between load and time during impact, the energy absorbed in the Charpy test was analyzed. The size effect of specimen width on the transition behavior was also examined. As a result of these, it was found that the transition in the present standard specimens was able to be divided into six temperature regions. Furthermore, the temperature at the shoulder of the transition curve ($\approx T_{r100\%}$) is considered to be important as a transition temperature because the energies divided have a tendency to reveal a peak value near this temperature range. Although a linear relationship was observed between the ductility transition temperature and the size of specimen width in the standard specimen, the size effect on the propagation transition temperature was not observed clearly. Similarly, in the crack-propagation type specimens such as press notch, press-boundary notch, and low-blow test specimens, the size effect was not observed. Such an effect rather appeared in the gradient from the shoulder of the transition curve in the standard specimens; and the temperature at the shoulder ($\approx T_{r100\%}$) was not affected by the specimen size. Therefore, this temperature is considered to be important as a crack-propagation transition temperature when correlations with a large specimen test are studied. (auth)

34059 MEDNOBERILLIYEVYYE SPLAVY, IKH SVOYSTVA, PRIMENENIYE I OBRABOTKA. **(Beryllium–Copper Alloys: Their Properties, Uses, and Processing). Berman, Samuil Lzraylevich. Moscow, Izdatel'stvo Metallurgiya, 1966. 343p.**

The processes of smelting, of preliminary and complex casting, rolling, forging, pressing, and drawing of semifinished pieces are described. Power requirements necessary for pressure forming of these alloys are given. Information on stamping, cutting on metal-working machines, soldering, welding, thermal treatment, and surface finishing of these alloys is also presented. (ATD)

34060 ISPARENIYE TUGOPLAVKIKH SOYEDINENIY. **(Evaporation of Refractory Compounds). Fesenko, Valentin Vasil'evich; Bolgar, Aleksandr Sergeevich. Moscow, Izdatel'stvo Metallurgiya, 1966. 179p.**

Methods of investigating the behavior of refractory metals, C, B, Si, carbides, borides, silicides, and nitrides in vacuum at high temperatures are described. Data on the evaporation rate and pressure of vapors of these substances and their thermodynamic properties are given. Information in international publications up to 1964 is summarized. (ATD)

34061 USE OF CORROSION RESISTANT STEELS AND ALLOYS IN NUCLEAR REACTOR CONSTRUCTION. Ruhland, Bernhard; Jaunich, Helmut. Dew Tech. Ber., 7: 146-50(June 1967). (In German).

Reactor-grade steels and alloys suitable for reactor construction are surveyed. These include X 5 CrNi 18-9, X 2 CrNi 18-9, X 10 CrNiTi 18-10 and X 10 CrNiNb 18-10 stainless steels. Pressure vessels are clad with weld deposited coatings of X 2 CrNiNb 19-9, X 2 CrNi 21-10 and X 2 CrNi 25-14 stainless steels. Canning materials developed to increase reactor output and temperature (as in breeders) include X 2 NiCr 25-20, X 2 NiCrAlTi 31-21 and X 2 CrNiMoNb 16-16. Nonaustenitic steels being used in reactor construction include X 8 CrMoTi 1-7, 10 CrMoNiNb 9-10 and X 5 CrNiCuNb 16-44. Alloys which can be used for the reprocessing of spent reactor fuel elements are X 1 NiCrMoCuTi 40-21, X 2 NiCrMoCuN 40-21, NiMo 30, NiCr 20 Mo 15, and Ti. (Rev. Metal Lit.)

34062 INFLUENCE OF INTERSTITIAL NITROGEN ON THE RECOVERY OF COLD-WORKED TANTALUM. Koethe, A.; Schlaet, F. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 649-57 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

Discussions are presented concerning recovery measurements of the electrical resistivity of cold-worked Ta containing 27 to 430 wt-ppM nitrogen at 300 to 800°K. Two recovery stages were found: a weak stage between 360 and 500°K and another more pronounced one between 550 and 670°K. The latter stage is missed in nitrogen-free Ta. This stage is believed to be caused by the migration of interstitial nitrogen atoms to dislocations. The samples containing nitrogen show a resistivity decrease greater than the increase due to deformation. (auth)

34063 STRUCTURE, ROLLING, AND ANNEALING CHARACTERISTICS OF MOLYBDENUM AND TUNGSTEN SINGLE CRYSTALS. Mueller, D.; Schlaubitz, K.; Wadewitz, H. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 747-54 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

Single crystals of Mo and W with a (001)/110/- orientation were 70% deformed by rolling at room temperature and 400°C, respectively. A substructure was established in the as-rolled condition with the Berg-Barrett-technique. Polygonization and no recrystallization was detected after annealing treatments up to 2400°C for Mo and 3000°C for W. No embrittlement was observed and the samples may be bent about 180°. (auth)

34064 ELASTIC CONSTANTS AND ANOMALOUS SELF-DIFFUSION IN B. C. C. TRANSITION METALS. Tiwari, G. P.; Sharma, B. D. (Bhabha Atomic Research Centre, Trombay, India). Scr. Met., 1: No. 3, 131-33(Dec. 1967).

The effects of non-linear temperature dependence of bcc transition metals elastic constants on entropy and enthalpy of diffusion in these metals are examined. Data obtained by various workers are used to illustrate the effects. (J.R.D.)

Structure and Phase Studies

34065 (MLM-1445) REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH, JANUARY-JUNE 1967. (Mound Lab., Miamisburg, Ohio). May 13, 1968. Contract AT(33-1)-Gen-53. 22p. Dep. CFSTI.

Phase studies of the Pu−U−Zr system indicate that the addition of Zr to Pu−U alloys results in formation of a single phase solid solution which is the primary phase in equilibrium with liquid for the complete ternary system. The solid solution is unstable at lower temperatures and dissociates over the range from 500 to 700°C into solid solutions of the binary phases. Six four-phase reaction isotherms were observed at 675, 660, 610, 585, 580, and 535°C. The density of liquid U was found to decrease from 17.252 to 17.082 g/cc between 1137 and 1245°C. Measured heat capacity of PuO_2 increased from 0.061 to 0.081 cal/g-°K between 300 and 900°K. (auth)

34066 (ORO-3395-5) THE INFLUENCE OF NEUTRON IRRADIATION, HEAT TREATMENT AND DEFORMATION ON THE MARTENSITIC TRANSFORMATIONS IN METASTABLE β_1-BRASS. Final Report. Hummel, R. E.; Koger, J. W. (Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering). Apr. 1968. Contract AT(40-1)-3395. 154p. Dep. CFSTI.

A study was made on the martensitic transformation in metastable β_1-Cu-Zn (with 38.3 to 39.4 wt % zinc) to determine the effect of repeated thermal cycling, deformation, annealing, bombardment with fast neutrons, and the presence of untransformable phases in these transformations. Transformations were monitored by measurement of electrical resistance complemented by optical and electron microscopy and x-ray diffraction analysis. The principal characteristics of the transformation on cooling, determined from resistance measurements, were found to be the M_s-temperature, the temperature coefficient of electrical resistivity of the phases, the area of the hysteresis loop of the transformation curve, and the rate of transformation. The M_s-temperature was found to change according to the treatment given the sample. Elastic deformation and the presence of retained martensite raised the M_s. The M_s-temperature was lowered after plastic deformation and neutron irradiation but was not affected by heat treatments up to 100°C. The neutron doses (ϕt) varied between 5×10^{16} and 5×10^{18} neutrons/cm^2 ($E > 1$ MeV). Neutron irradiation decreased the martensitic-start temperature (M_s) up to 8°C and increased the maximum rate of transformation. M_s was further decreased when β_1-brass was annealed at 150°C after irradiation. A small decrease in M_s was observed when unirradiated, quenched β_1-brass was annealed at 150°C. Possible mechanisms which give rise to the inhibition of the martensitic transformation, such as dislocation pinning, are discussed. Retained martensite formed during the first thermal cycle was found to be present at room temperature in samples which had an M_s-temperature above −33°C. The amount of retained martensite increased with increasing M_s-temperature. The shift of M_s between two cycles is a linear function of retained martensite. The retained martensite was observed to grow above the previously found M_s-temperature. Untransformable phases, such as α and deformation-martensite, acted as obstacles to the formation of low-temperature martensite. As the amount of these phases increased, the area of the hysteresis loop of the transformation curve increased; the maximum rate of transformation decreased; and the temperature range of transformation was spread over a wider range, thus increasing the amount of energy needed to complete the transformation. In samples which were irradiated with fast neutrons no such increase in the area of the hysteresis loop was detected, showing that the irradiation induced defects are only small disturbances. Using cold-stage electron microscopy it was observed that martensite formed immediately after a heavy bending movement of the foils. Differences in the growth mechanism during cooling and heating were found. (auth)

34067 PHASE EQUILIBRIA OF THORIUM–PRASEODYMIUM AND THORIUM–NEODYMIUM ALLOYS AND MAGNETIC PROPERTIES OF THEIR SOLID SOLUTIONS. Trzebiatowski, W.; Niemiec, J. (Technical Univ., Wroclaw). Rocz. Chem., 42: 413-19(1968). (In Polish).

Phase equilibria of binary alloys Th−Pr and Th−Nd were investigated by x-ray and thermal analysis. In the above systems solid solutions of broad existence range for Pr in $\alpha-$Th and Nd in $\alpha-$Th were found. The existence of any compounds was not ascertained. Praseodymium and neodymium dissolved in thorium increased the transition temperatures $\alpha- \rightarrow \beta$-Th. Similarly, the presence of thorium in Pr or Nd raised the transition temperatures $\alpha- \rightarrow \beta$-Pr and $\alpha- \rightarrow \beta$-Nd. The magnetic properties of the solid solutions were investigated within the temperature range from 85 to 300°K by the Faraday method; whereby the Curie−Weiss law was found to be obeyed. The magnetic moments of Pr and Nd attained 3.4 μB, which decreased to about 3.0 μB at low Pr or Nd concentrations. (auth)

34068 INVESTIGATION OF THE STRUCTURE AND SURFACE PROPERTIES OF SOME ALLOYS OF THE W–Mo–Re SYSTEM WITH ELECTRON AND ION PROJECTORS. Kuznetsov, V. A.; Povarova, K. B.; Savitskii, E. M.; Tylkina, M. A.; Tsarev, B. M. (Moscow Physico-Technical Inst.). Fiz. Metal. Metalloved., 25: 261-6(Feb. 1968). (In German).

In electron and ion hydrogen projector, the emission and structure properties of two binary and two trinary alloys of the W−Mo−Re system were investigated. The possibility was shown of the impoverishment of Mo in the surface layers of the alloys and correspondingly of the change in the phase composition of the alloy. It was discovered that the presence in the alloy of impurities causes a greater reduction of the work yield than probably can be explained by obtention by some investigators of low values of the work yield for alloys-solid solutions of refractory metals. (tr-auth)

34069 POSSIBILITY OF THE PREPARATION OF AN Al–$NbAl_3$ ALLOY IN DISPERSED PHASE BY RAPID TEMPERING OF THE LIQUID STATE. Beghi, G.; Matera, R.; Piatti, G. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater., 26: 219-22(1968). (In Italian).

Studies were conducted on the dispersion of $NbAl_3$ in the form of fine homogeneous particles in an Al matrix. The $NbAl_3$ was prepared in an arc furnace and then diluted with aluminum in an induction furnace. A soon as complete fusion was obtained, the alloy was cast. Micrographic analysis of the alloy showed that this technique can be used for the preparation of an Al-base material with $NbAl_3$ as dispersed phase. Initial studies were made on the thermal stability, mechanical properties, weldability, and corrosion behavior. The results are tabulated and graphed. (J.S.R.)

34070 CRYSTAL STRUCTURE AND THERMAL EXPANSION OF SCANDIUM, TITANIUM, VANADIUM, AND MANGANESE. Schmitz-Pranghe, Norbert; Duenner, Philipp (Univ., Cologne). Z. Metallk., 59: 377-82(May 1968). (In German).

X-ray methods were used to determine the lattice constants as a function of temperature of scandium, titanium, vanadium, and manganese. Measurements were made in the following temperature ranges: Sc from room temperature to 660°C, Ti and V from –180°C to 1500°C and Mn from –180°C to 950°C. Vanadium shows an anomaly at about –85°C, which is also marked by a sharp minimum of the coefficient of linear thermal expansion. In the case of manganese the linear expansion coefficient shows a sudden decrease below –100°C. The paramagnetic-antiferromagnetic phase transition, which is known to occur at about –180°C, is characterized by a minimum of the expansion coefficient. (tr-auth)

34071 PHASE COMPOSITION OF ALUMINUM-RICH WELDS ALLOYED WITH RARE EARTH METALS. Rabkin, D. M.; Ryabov, V. R.; Zalutskii, I. I.; Zalutskaya, O. I. Avtomat. Svarka, No. 8, 75-7(Aug. 1967). (In Russian).

The effect of rare earth metals (REM) on the tensile strength of Al has been investigated and found to be dependent upon the properties of the phases which are richest in Al. The Al-rich phases in binary systems of REM-Al are tabulated. The rare earth metals shown include La, Ce, Pr, Nd, Sm, Eu, Gd, Y, Tb, Dy, Ho, Er, Tm, Yb, Lu and Sc. The alloying of Al with mixtures of REM has also been examined. To confirm the hypothesis on the absence of brittle intermetallic phases in the Al corner of the multicomponent systems with REM of a third group, a study was made of the crystal structure of Al-rich alloys in the ternary system Er–Al–Sc. The alloys were made in an arc furnace in an Ar atmosphere, then annealed at 500 and 800°C and ground to powder which was studied by x-ray diffraction. Analysis of the Debye photographs showed that a continuous series of gamma solid solutions, in equilibrium with Al, exists between the isostructural compounds $ErAl_3$ and $ScAl_3$. The phase composition and the lattice periods of the phases in the Er–Al–Sc system are shown. (Rev. Metal Lit.)

34072 SLIP SYSTEM DETERMINATION WITH LIGHT AND ELECTRON MICROSCOPY OF CUBIC SPACE-CENTERED METALS. Kaun, L.; Luft, A.; Richter, J.; Schulze, D. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 489-500 of Realstruktur und Eigenschaften von Reinststoffie. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

A complete determination of slip planes in W single crystals deformed at room temperature requires, besides optical and x-ray methods, an additional electron microscopic examination of preselected slip line areas. Moreover, from such observations the active slip directions may be determined. The methods for determining the slip systems and the related problems are discussed. Slip was observed on planes of type (110) and type (123) along directions of type /111/. (auth)

34073 CHARACTERIZATION OF TUNGSTEN SINGLE CRYSTALS GROWN FROM THE GAS PHASE. Weise, G. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 305-12 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

Tungsten single crystals were prepared by vapor deposition of tungsten hexachloride on single crystal wires. The deposition temperatures were 1300, 2000, 2700°C and deposition times 1, 4, and 10 hours. The orientation of the rod axis was at all experiments near /110/. The exterior limiting planes are (110), (211), (100), (111) at high and (110), (211) at low supersaturation. At high supersaturation the planes appear macroscopically smooth, corresponding to the increased nucleation and reduced surface mobility. At low supersaturation the (211) and (110) planes show a profile characterized by (110) steps. The size of steps increases with lower supersaturation. Grain and subgrain boundaries of the substrate are continued into the deposited layer, while the number of dislocations diminishes. Results are illustrated by photomicrographs and x-ray topographs. (P.G.C.)

34074 ETCHING BEHAVIOR OF SMALL-ANGLE BOUNDARIES IN TUNGSTEN. Wadewitz, H. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 287-94 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

On type (100) surfaces of high purity zonemelted W single crystals the etching behavior of small-angle-boundaries is examined to determine the dependence of their crystallographic character. It is observed, that edge-dislocations are predominantly etched and that inhomogeneities in the distribution of decorating impurities give rise to differences in etch-pit densities. (auth)

Radiation Effects

Refer also to abstracts 33704, 34016, 34038, 34066, 34127, 35413, 35414, 35428, 35561, and 35658.

34075 (AECL–3086) EFFECT OF THE FAST NEUTRON SPECTRUM ON THE RATE AND DISTRIBUTION OF DAMAGE IN ZIRCONIUM. Piercy, G. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Apr. 1968. 33p. Dep. CFSTI. CAN $1.00.

The damage rate produced by neutron irradiation of Zr is calculated in terms of the energy given to the lattice. The effects of anisotropic elastic neutron scattering, inelastic neutron scattering, and energy loss to electron excitation using Lindhard's theory, are included. The results are applied to correlate the damage rate in seven different reactor spectra in terms of the associated ^{58}Ni monitor activity. The number of damage regions as a function of their lattice energy is also estimated and applied to several experiments. (auth)

34076 (AI-AEC–12670) HELIUM EMBRITTLEMENT OF TYPE 316 STAINLESS STEEL. Kramer, D.; Garr, K. R.; Rhodes, C. G.; Pard, A. G. (Atomics International, Canoga Park, Calif.). Apr. 30, 1968. Contract AT(04-3)-701. 31p. Dep. CFSTI.

He was injected into small tensile samples of type 316 stainless steel by alpha-particle irradiation from a cyclotron. Subsequent tensile testing at 540 to 815°C revealed a loss of ductility, as measured by elongation at failure. The lowest temperature at which a ductility loss was manifest depended upon the microstructure of the samples. A fine dispersion of sigma particles within the matrix was capable of raising this temperature by retarding the accumulation of He at grain boundaries. Reduced ductility was always accompanied by partial or complete intergranular failure and the presence of intergranular cracks. These cracks originated as small voids adjacent to grain-boundary carbide particles, presumably through the action of grain-boundary sliding. Large He bubbles found attached to carbide particles are responsible for the relative ease of void formation, as compared with samples without He. (auth)

34077 (BNL–12438) EFFECT OF IRRADIATION ON MECHANICAL PROPERTIES OF COBALT BASE ALLOYS. Chow, J. G. Y. (Brookhaven National Lab., Upton, N. Y.). [1968]. 10p. (CONF-680604–3). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

Commercial cobalt base alloys including Haynes 25 and UMCO 51 are potential fuel cladding materials at 650°C. These alloys are attractive over type 304 because of their higher strengths. The experimental alloys studied did not show advantages over the commercial alloys with respect to post-irradiation elevated temperature ductility. Cobalt base alloys are susceptible to decreasing ductility with increasing deformation temperature after irradiation. The mode of failure at 800°C is grain boundary tearing similar to that observed in stainless steels and nickel base alloys. (auth)

34078 (BNWL-SA–1442) IMPROVED TENSILE PROPERTIES OF HASTELLOY X-280 AND INCONEL 600 AFTER HIGH TEMPERATURE IRRADIATION. Levy, I. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 13, 1968. Contract AT(45-1)-1830. 33p. (CONF-680604–6). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

Tension specimens of Hastelloy X-280 and Inconel 600 that were given various experimental preirradiation treatments were irradiated at 1250°F to a fast fluence of approximately 1×10^{20} n/cm^2 (E > 1 MeV) in a thermal reactor. Then they (and their controls) were subjected to tension tests and electron microscopy. The experimental treatments produced significant improvements in both thermal stability and radiation stability, with the result that increases occurred in postirradiation uniform elongation, relative to standard treatments, of from 300% in Hastelloy X-280 to 550% in Inconel 600. These property improvements are rationalized in terms of interactions of the microstructure produced by the treatments with the thermal and radiation environments. (auth)

34079 (BNWL-SA-1455) POSTIRRADIATION TENSILE BEHAVIOR OF 300 SERIES STAINLESS STEELS. Holmes, J. J.; Robbins, R. E.; Lovell, A. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 20, 1968. Contract AT(45-1)-1830. 27p. (CONF-680604–7). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

The effects of neutron irradiation on the tensile properties of several austenitic stainless steels are considered over a wide fluence and temperature range. At low fluence levels (about 10^{20} n/cm^2), displacement damage results in radiation hardening if the irradiation and test temperatures are below one-half the absolute melting temperature (0.5 Tm) of the steel. Above 0.5 Tm, hardening no longer exists but a ductility loss due to helium embrittlement is observed. The temperature above which irradiation hardening is no longer significant increases with increasing fluence. The hardening observed at temperatures below 0.5 Tm is attributed to classical displacement damage. Elevated temperature hardening the fast reactor irradiations is the result of void formation. The hardening observed after thermal reactor irradiations appears to be due to the formation of gas filled bubbles, but the nature of the gas is not clear. (auth)

34080 (EURFNR–464) RESEARCH ON HIGH-TEMPERATURE EMBRITTLEMENT OF 16/13 CrNi STEELS AFTER NEUTRON IRRADIATION. Boehm, H.; Hauck, H.; Hess, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated from report KFK–712. 18p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The influence of B-content, C-content and a combined mechanical-heat-treatment, on the high temperature embrittlement of austenitic 16/13 CrNi-steels after neutron irradiation was investigated. The results established that the tensile ductilities of the irradiated specimens are independent of the B content (in the studied concentration range) whereas an increasing C-content improves the post irradiation ductility due to increasing carbide precipitation. It is further shown that the high-temperature embrittlement of the steel X8CrNiMoVNb 1613 can be influenced by a combined mechanical-heat-treatment. The post-irradiation ductility is improved by heavy cold-working prior to annealing. This effect may be related to the increased number of fine dispersed carbide particles. (auth)

34081 (ORNL-tr–1930) EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF IRON SINGLE CRYSTALS OF DIFFERENT CARBON CONTENT. II. PLASTIC STRESS-STRAIN CURVES. Seidel, Gerd-Peter. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Z. Metallk., 59: 82-8(1968). 16p. Dep. CFSTI.

This paper was abstracted from the original language and appeared in NSA as 22: 19592. (R.C.K.)

34082 (ORNL-tr–1931) THE EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF IRON SINGLE CRYSTALS OF DIFFERENT CARBON CONTENT. III. CHARACTERISTIC QUANTITIES OF STRAIN HARDENING. Seidel, Gerd-Peter. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Z. Metallk., 59: 88-93(1968). 12p. Dep. CFSTI.

This paper was abstracted from the original language and appeared in NSA as 22: 19591. (R.C.K.)

34083 (ORO–3098-8) PROGRESS REPORT [ON RADIATION DAMAGE IN METALS], APRIL 1968. Chaplin, R. L. (Clemson Univ., S. C.). Contract AT(40-1)-3098. 7p. Dep. CFSTI.

Results of electron beam radiation damage to specimens of Al, Cu, and Mg are reported. (P.G.C.)

34084 (WAPD-Trans–87) THE EFFECT OF RADIATION ON THE CORROSION OF ZIRCALOY 2 IN AQUEOUS SOLUTIONS AT HIGH TEMPERATURES. A Study of Zirconium Alloys to be Used in Superheated Steam. Blanchet, J.; Coriou, H.; Grall, L.; Mouhot, R.; Pelras, M. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from J. Nucl. Mater., 22: 55-67(1967). 30p. Dep. CFSTI. JCL $3.60 fs, $1.22 mf.

This paper was abstracted from the original language and appeared in NSA as 21: 16624. (R.C.K.)

34085 MECHANISM OF LOW NEUTRON DOSE RADIATION GROWTH OF URANIUM. Konobeevskii, S. T.; Levitskii, B. M.; Panteleev, L. D. At. Energ. (USSR), 24: 312-16(Apr. 1968). (In Russian).

The nature of α-uranium directed deformation (growth) as induced by neutron irradiation is discussed. Two-stage process is assumed to be the basis of uranium growth. The first stage is accumulation of single defects (vacancies and interstitials) effected throughout the metal volume by irradiation. Two types of defects are considered: in α-uranium lattice interstitials may occupy either positions with coordination number 5 (pyramids) or positions with coordination number 4 (6)(octahedrons). The former induce crystal elongation along y-axis, the latter are not accompanied by an appreciable deformation. The choice of either position should depend on the lattice defects available before irradiation. The second stage of growth following the first one when sufficient number of radiation defects are accumulated is related to the prismatic displacement of atom lamellae (010) in the direction $\langle 110 \rangle$ at the Burgers vector $\frac{1}{2}$ [110] as a result of which 100p dislocations are formed, that surround an additional region of planes (010). According to the ideas being developed the crystal growth along the y-axis is determined by the anisotropic form of primary defects and not by the existence of anisotropic stresses in the displacement spike regions. Based on the proposed mechanism the recent principal experimental data are considered on uranium growth as induced by low dose irradiation. (auth)

34086 RADIATION STABILITY OF BORIDES. Samsonov, G. V.; Koval'chenko, M. S.; Ogorodnikov, V. V.; Krainii, A. G. At. Energ. (USSR), 24: 191-2(Feb. 1968). (In Russian).

Boron-containing materials would be expected to show heavy lattice damage because of a 4010 barn cross-section on the ^{10}B isotope (19% natural abundance) for the following reaction: $^{10}\mathrm{B} + \mathrm{n} \rightarrow {}^{7}\mathrm{Li} + {}^{4}\mathrm{He} + \gamma + 2.78$ MeV. Samples of TiB_2, $(Ti,Cr)B_2$, LaB_6, CrB_2, and ZrB_2 were given an irradiation dose of 10^{20} thermal neutrons/cm^2 (sample diameter of 8 mm and a height of 10 to 15 mm). The irradiation temperature was <100°C. It was found that irradiation led to the appearance of cracks in TiB_2 and $(Ti,Cr)B_2$, while the ZrB_2, CrB_2, and LaB_6 samples were broken up into bits having a size of one to a few mm. The radiation stability of the substance was correlated with the modulus of elasticity E. A maximum lattice expansion of 3.1 vol % was observed in the case of TiB_2, while ZrB_2 showed a lattice volume expansion of only 0.9%. (TTT)

34087 EFFECTS OF NEUTRON IRRADIATION ON THE IMPACT PROPERTIES OF WELDED JOINTS OF Ni–Cr–Mo HIGH STRENGTH STEEL PLATE FOR NUCLEAR REACTOR VESSELS. Susukida, Hiroshi; Ando, Tomozumi (Mitsubishi Heavy Industry, Ltd., Japan). Mitsubishi Juko Giho, 5: 115-20(Mar. 1968). (In Japanese).

Results of an experimental study on the effects of neutron irradiation (irradiation temperature: 75°C, neutron dose: $3.1 \sim 3.2 \times 10^{19}$ nvt, >1 MeV) on the Charpy V impact properties of welded joint of Ni–Cr–Mo high strength steel plate (modified HY 80) are presented. The transition temperature T_{r35} of the welded joint after the neutron irradiation showed an increase of 165°C in the weld metal, an increase of 138°C in the bond and an increase of 149°C in the heat affected zone over their respective temperatures before the irradiation. These increases are almost equal to those in the base metal and it was also confirmed that the welded joint has less sensitivity to neutron irradiation embrittlement than the steels of the same kind. (NSA of Japan)

34088 NEUTRON IRRADIATION TEST OF HEAVY SECTION STEELS FOR NUCLEAR REACTOR PRESSURE VESSELS. Matumoto, Sigeki; Kobayasi, Takesi (Japan Steel Works, Ltd., Tokyo). Nippon Seiko Giho, No. 23, 2620-34(1967). (In Japanese).

With the increasing power of nuclear power plants, heavier section steels are used for the pressure vessels. Therefore, pressure-vessel steels of practical sizes were produced and test specimens from the steels were subjected to neutron irradiations to reveal their mechanical properties, especially, changes in toughness. The results of tests showed that the brittleness after irradiation of the steels produced was similar to, or even smaller than, that of the steels in other countries. It was further shown that the A302B (mother) steel was insensitive to high-temperature neutron irradiation. The steels tested were observed to satisfy the qualities required for the reactor pressure vessels. (NSA of Japan)

34089 IMPORTANT ROLE PLAYED IN THE SWELLING OF URANIUM BY THE FISSION PRODUCTS WITH HIGH ATOMIC RADIUS CESIUM, STRONTIUM, BARIUM, CERIUM, AND NEODYMIUM. Blanchard, P. (Centre d'Etudes Nucleaires, Saclay, France). J. Nucl. Mater., 26: 241-5(1968). (In French).

An hypothesis is presented which ascribes the swelling of U to fission products with high atomic radius. In support of this hypothesis it is shown that the fission products probably precipitate on the same sites as the rare gas atoms. The number of atoms of fission products of high atomic radius is sufficient to form a monolayer adsorbed at the surface of bubbles. The segregation of these atoms at the surface of bubbles causes a reduction in the free energy of the system. The segregation also causes a significant reduction of the surface energy of the bubbles. (J.S.R.)

34090 SWELLING OF URANIUM ALLOYS UNDER IRRADIATION. Lehmann, J.; Paoli, P.; Azam, N. (Centre d'Etudes Nucleaires, Saclay, France). J. Nucl. Mater., 26: 238-40(1968). (In French).

The swelling of uranium alloys under neutron irradiation of 3.7×10^{13} to 1.9×10^{14} n/cm^2 sec was studied at temperatures from 400 to 550°C for four alloys: U–1 wt % Mo, U–1.1 wt % Mo–0.05 wt % Al–0.05 wt % Sn, U–0.07 wt % Al–0.03 wt % Fe–0.012 wt % Si–0.008 wt % Cr, and U–0.08 wt % Al–0.03 wt % Fe–0.035 wt % Si–0.020 wt % Cr. All four alloys have a swelling maximum between 450 and 500°C and a temperature threshold at 400°C. The swelling rate is slightly less for U–Mo than for the other three alloys and for all four it is much less than for unalloyed U. A hydrostatic pressure of 40 bar reduces the swelling significantly. The breaking of the α phase, observed previously after low temperature irradiation, was detected at much higher temperatures in all the alloys. The breaking up of the α grain leads to regions whose size varies with the temperature, but the disorientation between regions decreases. The polygonization substructure thus formed was detected up to 475° in U–Al–Fe–Si–Cr, and up to 600°C in U–Mo. This α substructure favors the enlargement of gas bubbles. (J.S.R.)

34091 EFFECT OF PHASE COMPOSITION OF THE THERMAL STABILITY OF ZIRCONIUM DIOXIDE. Grebenyuk, A. A. (Ukrainian Scientific Research Inst. of Refractory Materials, Kharkov); Karaulov, A. G.; Dauknis, V. I.; Prantskyavichyus, G. A.; Yurenas, V. L. Ogneupory, No. 1, 42-9(Jan. 1968). (In Russian).

The results of the thermal stability of samples, prepared on the basis of granular mass from stabilized (cubic) ZrO_2, containing up to 40% of the monoclinic phase were reported. In the interval from 30 to 1600 to 30°C, the thermal exchange method with 20% weight loss appeared the most satisfactory. Samples, containing 20 to 40% of the monoclinic phase had the greatest thermal stability. (tr-auth)

34092 DEYSTVIYE OBLUCHENIYA NA MATERIALY; VVEDENIYE V RADIATSIONNOYE MATERIALOVEDENIYE. (Effects of Irradiation on Materials: Introduction to Radiation Study of Materials). Konobeevskii, Sergei Tikhonovich. Moscow, Atomizdat, 1967. 400p.

The effects of irradiation on material properties, the theory of atomic collision, and experimental methods of material irradiation with various kinds of irradiation such as electron, γ-rays, neutrons, are described as well as defects arising in material structure under the effect of irradiation and the effect of defects on the physical and mechanical properties of solids. The effects of irradiation on materials used in reactor structures, such as U and its alloys, oxides and carbides, steel, and graphite are also described. (ATD)

34093 DEPENDENCE OF THE BORDONI INTERNAL FRICTION MAXIMUM UPON DISLOCATION LOOP LENGTH. Thompson, D. O. (North American Aviation Science Center, Thousand Oaks, Calif.). pp 597-614 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967.

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

Studies of the Bordoni internal friction maximum as a function of the dislocation loop length have been made using neutron irradiation as a tool. From these studies it appears probable that, of the several models which have been proposed to account for the maximum, only Seeger's is consistent with the results. (auth)

34094 EFFECT OF IONIZING RADIATION AND PLASTIC DEFORMATION ON MICROHARDNESS OF POTASSIUM CHLORIDE CRYSTALS WITH VARIOUS QUANTITIES OF INITIAL VACANCIES. Damm, J. Z. (Inst. of Structural Research, Wroclaw); Suszynska, M. pp 565-76 of Realstruktur ung Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967.

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

The microhardness and dislocation density in KCl crystals are examined as the function of both plastic strain and the dose of ionizing radiation. The results obtained explain the effect of various irradiation conditions and reveal the agents responsible for the observed microhardness changes in irradiated crystals. (auth)

Ceramics and Cermets

Refer also to abstracts 33518, 33601, 33602, 34005, and 34007.

Corrosion and Erosion

34095 (LA-3822) EVALUATION OF YTTRIA IN MOLTEN BARIUM AND LITHIUM. Keddy, Edward S. (Los Alamos Scientific Lab., N. Mex.). Oct. 1967. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Yttria were tested for possible use in high-temperature thermionic converters. Specimens of 98.7% Y_2O_3 withstood 1000 hr at 1000°C in vacuo, but disintegrated when refired to 2000°C. Similar specimens failed after having been immersed in molten Ba or molten Li when heated to 1000°C. Samples of 99.5% Y_2O_3 withstood all the tests in good condition although some surface attack after Ba or Li immersion indicated limited use in such an environment. Impurities affect the heat resistance of Y_2O_3 significantly and must be held to a minimum if Y_2O_3 is to be used in high-temperature thermionic converters. (auth)

Preparation and Fabrication

Refer also to abstracts 34017 and 34022.

34096 (GMAD-3078-21) DEVELOPMENT OF AGGLOMERATE SINTERED CERMET FUEL. Fuhrman, N.; Holden, R. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 62p. (EDR-4187). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind., Allison DIV+

The objective of the Military Compact Reactor (MCR) program is the development of a self-sufficient, compact, lightweight, reliable, and safe nuclear powerplant suitable for a variety of military applications, including mobile electrical power generation. Methods for the fabrication of highly loaded UO_2–Nb cermet fuels developed include hot pressing, hot isostatic pressing, and agglomerate sintering. The fabrication technique development and physical properties measurements on agglomerate sintered fuel is reported. In-pile irradiation is under way. Technical feasibility of agglomerate sintering was established and the necessary controls over starting materials and techniques were developed for the reproducible fabrication of good 80 vol % loaded cermets. Bonding of Nb–1% Zr clad to the cermet was achieved through hot isostatic pressing, and irradiation specimens were fabricated. The fuel materials resulting from these efforts are of 94 to 95% theoretical maximum density. The connecting matrix is sound and near-uniform distribution can be achieved routinely. (auth)

34097 (GMAD-3078-25) DEVELOPMENT OF HOT ISOSTATIC PRESSED CERMET FUEL. Fuhrman, N.; Holden, R. (United Nuclear Corp., White Plains, N. Y. Development Div.). May 3, 1965. Contract AT(30-1)-3078. 78p. (EDR-4192). Dep. CFSTI.

For General Motors Corp., Indianapolis, Ind., Allison Div.

The development of fabrication techniques and properties measurements on hot isostatic pressed (HIP) fuel is reported. The HIP fuel pin fabrication process consisted of packing Nb-coated UO_2 shot into a Nb–1% Zr tube by a vibration-assisted pouring technique. Following end closure by electron beam welding, the tube was autoclaved in 10,000-psi He at 2300°F to concurrently densify the fuel and form a complete metallurgical bond between the Nb matrix and cladding. Cermet densities as high as 98% of theoretical were attained with uniform microstructures exhibiting a continuous Nb matrix surrounding the UO_2 particles. The feasibility of fabricating bonded clad fuel pins of 3-MW(e) MCR design loading (80 vol % UO_2–20 vol % Nb), length (16 in.), diameter (0.41 in.), and clad thickness (0.015 in.) by HIP was established. A reverse bending method of straightening long pins was demonstrated successfully without significantly affecting fuel integrity. (auth)

34098 (JEN-190-DMe/1-18) OBTENCION DE ESTEATITA POR PRENSADO EN CALIENTE. (Hot Pressing of Steatite Bodies). Aparicio Arroyo, Elias (Junta de Energia Nuclear, Madrid (Spain)). 1967. 22p. (In Spanish). Dep.

Special nuclear engineering ceramic shapes are required which have large size, impervious, dimensional accuracy and good mechanical and dielectric properties. Limitations of conventional methods and advantages of hot pressing techniques for the manufacturing of these shapes are discussed. Hot-pressing characteristics of a certain steatite powder are studied. Occurrence of an optimum densification temperature just above the talc decomposition range was found. Experimental data show that the height/diameter ratio of the specimen has no effect on the sintering conditions. Increasing darkness from the graphite mold was detected above the optimum temperature. The hot-pressed steatite is compared with a fired dry-pressed sample of the same composition. Fabrication pressure and temperature of the hot-pressed body are lower by a factor of 10 and 150°C; the material also exhibits higher mechanical strength and dimensional accuracy, as a consequence of its decreased porosity and shrinkage, with similar dielectric characteristics to those of the conventional steatite. (auth)

34099 (KFK–708) ISOSTATISCHES HEISSPRESSEN: EIN NEUES VERDICHTUNGSVERFAHREN DER PULVERMETALLURGIE. (Isostatic Hot Pressing: A New Compaction Method for Powder Metallurgy). Bumm, H.; Thuemmler, F.; Weimar, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Jan. 1968. 23p. (In German). (EUR–3717). Dep.

A new compaction method for powders, isostatic hot pressing, is described. The process occurs at high temperatures and pressures in an autoclave. The samples are in a thin-walled metal holder, which transfers the isostatic gas pressure to the powder and takes it to theoretical density. An installation working at 1600°C and 1000 atm was developed and tested. The physical characteristics of a hot-pressed sample of $UO_2-10\%$ Mo were measured and compared with the values taken from the literature. (tr-auth)

34100 (MLM–1508(tr)) THE DEPOSITION OF MOLYBDENUM ON ZrO_2 AND UO_2 SPHERES FROM THE GAS PHASE. Schneider, H.; Schonwald, D. Translated for Mound Lab., Miamisburg, Ohio, from report KFK–555. 28p. Dep. CFSTI.

The deposition of metallic molybdenum from the gas phase by reduction of molybdenum pentachloride was considered for the coating of UO_2 spheres. In the course of the first experiments with zirconium oxide spheres, it was ascertained that $MoCl_5$ not supplied in ampules is very strongly contaminated with oxygen and must be freshly sublimed before each experiment. The process course was next tried on small charges of zirconium oxide spheres, whereby up to 25 weight-% of Mo was put on, and then carried over to uranium dioxide spheres. By this, up to 21 weight-% of Mo was vapor-deposited with charges of 100 g UO_2. The process technique was improved so far until 100 g UO_2 charges were able to be provided with pure molybdenum coatings with certainty and good yield. The surface quality of the molybdenum deposited was judged visually under a microscope, its purity established with the aid of chemical and x-ray diffraction methods. To the parameters concerning coating quality and yield, particular consideration was given to the vaporization rate and gas velocity. (tr-auth)

34101 (ORO–2570-12) METHOD FOR THE CONTROLLED ADDITION OF OXYGEN TO COLUMBIUM. Gerber, James D.; Rizzo, Frank E.; Daniels, Raymond D. (Oklahoma Univ., Norman. Coll. of Engineering). May 1968. Contract AT(40-1)-2570. 25p. Dep. CFSTI.

A technique for making additions of small amounts of oxygen to Nb is presented. The technique involves complete reduction of a carefully weighed metal–metal oxide mixture by the Nb in a sealed evacuated chamber at 900°C. The oxygen pressure in equilibrium with the metal–metal oxide mixture was found to be quite critical. Large oxygen pressures resulted in severe surface oxidation while low oxygen pressures did not permit reduction in a reasonable amount of time. Using iron-wustite (Fe_xO) mixtures, controlled additions of 15 to 300 ppM oxygen were made to Nb. The technique makes possible oxygen additions within 4 ppM of the desired composition. (auth)

34102 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF CARBON OR GRAPHITE BODIES. (to Siemens-Planiawerke Aktiengesellschaft fur Kohlefabrikate). British Patent 1,115,755. May 29, 1968. Priority date Nov. 17, 1965, Germany.

A process for sealing porous carbon or graphite bodies is described. The sealing process comprises impregnating the body with a carbonizable impregnating agent, applying a carbonizable polymeric coating over the impregnating agent to prevent it vaporizing, and carbonizing the impregnating agent in the carbon or graphite pores. (J.R.D.)

34103 INVESTIGATION OF THE DOUBLE OXIDES FORMED BY THE INTERACTION OF Nd_2O_3, Sm_2O_3, AND Er_2O_3 WITH TUNGSTEN TRIOXIDE. Trunov, V. K.; Tyushevskaya, G. I.; Afonskii, N. S. (Moscow State Univ.). Zh. Neorg. Khim., 13: 936-9(Apr. 1968). (In Russian).

The double oxides Er_2WO_6, Y_2WO_6, Sm_2WO_6, Nd_2WO_6, Nd_6WO_{12}, Sm_6WO_{12}, Er_6WO_{12}, and $11Er_2O_3 \cdot 6WO_3$ were produced. The identity periods of the sub unit cell compounds Me_2WO_6 (Me = Er, Y, Sm, Nd) and $3Me_2O_3 \cdot WO_3$ (Me = Nd and Sm) were determined. The parameters of the complete unit cell were determined for Er_6WO_{12} and $11Er_2O_3 \cdot 6WO_3$. (tr-auth)

34104 OXIDE CARBIDES OF CHROMIUM, MOLYBDENUM, TUNGSTEN, AND VANADIUM. Lux, Hermann; Ignatowicz, Anita (Technische Hochschule, Munich). Chem. Ber., 101: 809-14 (1968). (In German).

Whereas the thermal decomposition of chromium hexacarbonyl in vacuum and in hydrogen current yielded fcc chromium oxide carbide, an additional tetragonal chromium oxide carbide is formed in the hydrogen current at hydrogen pressures of 2 to 30 torr at 300 to 500°C. The hexacarbonyls of Mo, W, and V are also converted at 300 to 500°C in vacuum to the face-centered cubic oxide carbide. Molybdenum oxide carbide and tungsten oxide carbide yield, above 800°C, new hexagonal isotype carbides. (tr-auth)

34105 METAL OXIDES. (to Comitato Nazionale per l'Energia Nucleare). British Patent 1,116,535. June 6, 1968. Priority date June 24, 1964, Italy.

A process is described for producing dense particles of oxides of actinides which are suitable for use as fuels for nuclear reactors, particularly uranium dioxide, uranium and plutonium oxide, and thorium plutonium oxide, and thorium and uranium oxide. The starting solution is an acid-deficient solution of actinide nitrate and the colloid of the oxide is obtained directly through a catalytic reduction with hydrogen of the nitrate solution. (P.C.H.)

34106 YADERNYY GRAFIT. (Nuclear Graphite). Vyatkin, S. E.; Deev, A. N.; Nagornyi, V. G.; Ostrovskii, V. S.; Sigarev, A. M.; Sokker, G. A. Moscow, Atomizdat, 1967. 278p.

Data are summarized on the properties and methods of producing artificial graphite, which is widely used as a structural material in different parts and units employed in atomic engineering. The technology of producing artificial graphite for nuclear moderators is outlined as well as its crystalline porous structure, electron, thermodynamic, thermal, mechanical properties and its interaction with some elements and compounds. Attention is paid to the production of different types of graphite of high density and low penetrability and to the description of its properties. The behavior of graphite in nuclear reactors is discussed at length. Special attention is paid to the description of new types of graphite materials and types of graphite existing in non-Soviet countries, which are used lately as moderators of neutrons. (ATD)

34107 OXIDATION RESISTANT COATINGS FOR REFRACTORY METALS IN AIRCRAFT GAS TURBINE ENGINES. Restall, J. E. Metals Mater, 1: 241-6(Aug. 1967).

The high-temperature strength of Nb, W, Mo and Ta refractory alloys is shown in comparison with wrought and cast Ni alloys. The four refractory metals are readily attacked and contaminated by exposure to O_2-bearing atmospheres at high temperatures. Work on developing coatings for oxidation protection includes the application of plain niobium disilicide coatings to unalloyed Nb by H_2 reduction of $SiCl_4$ at temperatures of 1100 to 1200°C, or alternatively, by pack cementation from a Si-metal powder pack, using I_2 as the halide activator. Molybdenum disilicide coatings were also developed using vapor plating of Mo from $MoCl_5$ vapor. The oxidation resistance of both these coatings proved to be inadequate. A composite coating for Nb alloys was developed, consisting of a diffusion-bonded silicide coating with a glaze overlay. The coated material can withstand significant high-strain-rate deformation at high temperatures without loss of coating integrity. (Rev. Metal Lit.)

Properties Evaluations

Refer also to abstracts 34050 and 34060.

34108 (LA–3932) CMF-13 RESEARCH ON CARBON AND GRAPHITE REPORT NO. 5. Summary of Progress, February 1–April 30, 1968. Smith, Morton C. (Los Alamos Scientific Lab., N. Mex.). May 1968. Contract W-7405-eng-36. 38p. Dep. CFSTI.

The physical and mechanical properties of graphites, carbon black, coke, binding resins, and coal tar pitch, used in reactor programs, were investigated by x-ray diffraction, electron and optical microscopy, and porosimetry. Grinding behavior, extrusion methods, and properties of extruded rods are discussed. (P.G.C.)

34109 ELASTIC PROPERTIES OF SOME DIE-PRESSED COMPOSITES OF TaC–NbC SOLID SOLUTIONS WITH GRAPHITE. Brown, H. L.; Kempter, C. P. (Los Alamos Scientific Lab., N. Mex.). Planseeber. Pulvermet., 16: No. 1, 34-8(Apr. 1968).

The elastic properties of die-pressed composites containing 23.0, 22.1, and 20.0 wt % graphite and respective nominal weight proportions of 10 : 90, 30 : 70, and 50 : 50 of TaC and NbC in solid solution were determined dynamically at 23°C on cube samples. Two sets of values were obtained, indicating directionality in the materials, in the manner of graphite. The properties are reported as corrected to full density. In units of 10^6 lb/in.^{2}, the average Young's moduli in the strong and weak directions are, respectively, 16.7 and 11.2, 16.6 and 10.4, 17.1 and 9.6. The corresponding average shear moduli are 7.2 and 5.4, 7.2 and 5.2, 7.2 and 5.4. In every case the modulus values are higher than those of NbC–C materials having equivalent vol % graphite and no TaC substitution. (auth)

34110 CALCULATING THE THERMAL RESISTANCE OF THE CONTACT ZONE BETWEEN SOLIDS. Prasolov, R. S. At. Energ. (USSR), 24: 86-7(Jan. 1968). (In Russian).

Temperature drops of 100 to 200°C can occur in gaseous gaps of 10 to 30 μ at thermal fluxes characteristic of fuel elements. The total thermal resistance is due primarily to the gas resistance R_g with contributions from the metal contact resistance R_m due to conduction and the radiant heat transfer resistance R_r. On neglecting R_m and R_r, the value of R_g is calculated from the thermal conductivity of the gas λ_g which is expressed as a function of the Knudsen number Kn, the adiabatic coefficient and other terms. The thermal resistance as a function of gas pressure is plotted for an air-stainless steel and for a helium-magnox interface. The contact conductivity $\alpha = 1/R$ as a function of gas pressure is given for a Al–U fuel element with He and H_2 as the carrier cooling gases. The calculated results agree with the experimental results to an accuracy of 5 to 10%. (TTT)

34111 QUESTIONS ON THE VAPORIZATION OF THE COMPONENTS OF ZIRCONIUM CERAMICS. Rutman, D. S.; Shchetnikova, I. L.; Ignatova, T. S.; Semenov, G. A. Ogneupory, No. 1, 49-52(1968). (In Russian).

The dynamics of the change in the compositions of the evaporation products and the conditions for the maintenance of the stabilization of zirconium dioxide were investigated. From solid solutions of zirconium dioxide, stabilized with CaO, at temperatures above 2000°C, an intense distillation of the CaO occurs, and destabilization is observed only at CaO contents less than 0.5%. From solid solutions of zirconium dioxide, stabilized with yttrium oxide, the evaporation of the stabilizing additions occurs in the forms of YO at temperatures above 2200°C. Simultaneously with the evaporation of YO, evaporation of zirconium dioxide takes place. (tr-auth)

34112 ACCESS OF GASES TO THE POROSITY OF SYNTHETIC GRAPHITE AT HIGH TEMPERATURES. Napier, B. A.; Spencer, D. H. T. (British Coal Utilization Research Association, Leatherhead, Eng.). Nature (London), 218: 948-9(June 8, 1968).

It has been found that much, if not all, of the so-called "closed porosity" in nuclear grade graphite lies beyond very fine entrances, which can be penetrated by certain gases at high temperatures. It follows that the gradual decrease in "closed porosity" which occurs on thermal oxidation can be accounted for by erosive widening of such entrances. These conclusions are the result of two independent methods for measuring porosity changes, which have been applied from room temperature to 1073°K. The first is the well-known helium density method; densities obtained by this method, at room temperature, are always significantly lower than the average densities of the carbon structures, which suggests the existence of porosity closed to helium. Displacement-density results for PGA graphite in helium and nitrogen at various temperatures between 298 and 1013°K are tabulated. The second method was developed specifically to make independent measurements of any increase in porosity accessibility with temperature increase. The procedure is to immerse the previously evacuated graphite in a gas at elevated temperature (T), and then cool to room temperature, the gas pressure remaining approximately constant. Gas entering pores at high temperature becomes trapped during cooling. After evacuation at room temperature the graphite is reheated to temperature T and the released gas measured mass spectrometrically. Results for PGA graphite are tabulated (for T = 773 and 1073°K). Although it is not possible to evaluate the volume of pores from which trapped gas is released in this cyclic experiment, since the temperature at which the gas is actually trapped is unknown, the pore volume must lie between the volumes that the released gas would occupy at the admission pressure and at the maximum and minimum temperatures of the experiment. It was found that the porosity of PGA is markedly more accessible to helium at high temperatures. The drastic reduction in the helium effect after grinding is also discussed, in relation to the behavior of lump graphite. At high temperatures the "closed porosity" behaves as a molecular sieve. Studies by others in this field are also briefly discussed. (UK)

34113 PROPERTIES OF ZIRCONIUM DIOXIDE LAYERS PRODUCED BY GAS-FLAME COATING. Ezerskii, M. L.; Kolesnikov, E. I.; Bagotskii, V. S.; Trofimov, M. G.; Rastorguev, L. N. Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 549-52(Apr. 1968). (In Russian).

The influence of gas-flame deposition on the structural and electric properties of CaO solutions in ZrO_2 containing 10 to 18 mole % CaO was studied with specimens of ZrO_2 stabilized at 1700°C. Total stabilization of deposited ZrO_2 specimens was reached with a smaller content of CaO as compared with sintered ZrO_2. Deposition of ZrO_2 + CaO at 600 to 1000°C revealed that the electric conductivity, $\varkappa$, of the specimen does not depend on the amount of CaO at 10 to 18 mole %. In the specimens containing 12 and 15 mole % CaO, the conductivity was about one tenth the values obtained for sintered specimens of identical content. (R.V.J.)

34114 ENTHALPY AND HEAT CAPACITY OF SAMARIUM AND EUROPIUM SESQUIOXIDES AT HIGH TEMPERATURE. Gvelesiani, G. G.; Tsagareishvili, D. Sh.; Yashvili, T. S. (Inst. of Metallurgy, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 553-6(Apr. 1968). (In Russian).

A mixing method in a massive calorimeter was used to determine the enthalpy of C-form Sm_2O_3 in a temperature range from 298.15 to 1147°K, and B-form Sm_2O_3 and Eu_2O_3 at temperatures from 298.15 to 1600°K. Empirical equations of enthalpy and intrinsic heat capacity as functions of the temperature were obtained and tabulated data constructed of smoothed magnitudes of enthalpies. (tr-auth)

34115 PROCHNOST' TVERDYKH SPLAVOV. (Strength of Hard Alloys). Kreimer, Gersh Semkhovich. Moscow, Izdatel'stvo Metallurgiya, 1966. 199p.

Experimental findings are outlined concerning the strength of hard alloys at various temperatures, which depends upon the alloy composition and structure. Also analyzed are hypotheses which connect the strength of WC–Co alloys with their structure and thermal stresses. The theory of the mechanism of alloy failure and strength is discussed and the result of alloying hard alloys with TaC is described. (ATD)

Structure and Phase Studies

34116 (WAPD-Trans-0091) CONTRIBUTION TO THE STUDY OF THE OXIDATION OF ZIRCONIUM AND OF THE DIFFUSION OF OXYGEN INTO THE OXIDE AND INTO THE METAL. Debuigne, Jean. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Metaux (Corros.-Ind.), 42: 235-58(1967). 66p. Dep. CFSTI.

This paper was abstracted from the original language and appeared in NSA as 21: 46018. (R.C.K.)

34117 IDENTIFICATION OF THE PHASES APPEARING IN INDUSTRIAL METAL CARBIDES WITH THE HELP OF MICROPROBES AND BY ACID ETCHING. Mader, W.; Mueller, K. F. (Gebr. Boehler and Co., AG., Kapfenberg, Austria). Planseeber. Pulvermet., 16: No. 1, 39-44(Apr. 1968). (In German).

The phases occurring in commercial grades of cemented carbides were analyzed by means of a microprobe and the concentration profile determined by scanning of the crystals on a polished section. The results of these investigations made it possible to identify and mark the phases. In order to obtain maximum color contrast in the structure, the most suitable temperature for a temper etch was determined in a test series. Since the maximum x-ray resolution of the microprobe is only 2 to 3 microns, model alloys with a crystal size above this value had to be prepared. (auth)

34118 STABLE SUBSTOICHIOMETRIC CERIUM OXIDE FORMED IN AN AIR PLASMA. Gilman, W. S.; Seabaugh, P. W.; Sullenger, D. B. (Mound Lab., Miamisburg, Ohio). Science, 160: 1239(June 14, 1968). (MLM-1497J).

Cerium dioxide was reduced to a stable, substoichiometric monophase in an air plasma. This phase has been identified as $CeO_{1.34}$ by thermal gravimetric analysis. The existence of a stable, reduced phase of cerium oxide can be explained by interpretation of both theoretical and experimentally determined crystal data. (auth)

34119 INFRARED SPECTRA AND MOLECULAR STRUCTURE OF THE URANATES OF SOME RARE EARTH ELEMENTS.

Zubova, N. V.; Makarov, V. M.; Nikol'skii, V. D.; Petrov, P. N.; Teterin, E. G.; Chebotarev, N. T. Zh. Neorg. Khim., 13: 940-7(Apr. 1968). (In Russian).

In all the compounds studied, formed in the systems $R_2O_3-UO_3-H_2O$ at 270°C (R = La, Pr, Nd, Sm, Y, and Sc), with the exception of $La(OH)(OH_2)_{0.8}[(UO_2)O_2]$, water occurs in the molecular form and is bound with coordination bonds with the atoms of the rare earth elements. In the La compound water occurs both in the molecular form and in the form of the hydroxyl group. Structural and molecular formulas were proposed for the synthesized aquaoxydiuranates of La, Pr, and Nd, the oxyuranates of Sm, Y, and Sc, the aquahydroxyuranate of La, and the aquaoxyuranates of Pr, Nd, and Sm. (tr-auth)

34120 CRYSTALLINE STRUCTURE OF THE WV_2O_7 PHASE. **Mondet, Suzanne; Rimsky, Alexandre; Borene, Jacques; Freundlich, William (Faculte des Sciences, Paris). Compt. Rend., Ser. C, 266: 1145-8(Apr. 8, 1968). (In French).**

An earlier study of the W−V−O system by thermolysis or by W reduction of an equimolar mixture of WO_3 and V_2O_5 showed the existence of two ternary phases, tetragonal $WV_2O_{7.5}$ and monoclinic WV_2O_7. The present work concerns a structural study of the monoclinic phase. A hypothesis was presented to explain the space lattice. (J.S.R.)

34121 ON THE INVESTIGATION OF YTTRIUM TUNGSTATE−THORIUM TUNGSTATE SYSTEM. **Afonskii, N. S.; Pokrovskii, A. N.; Trunov, V. K. Vestn. Mosk. Univ., Ser. II. Khim., No. 6, 86-7(Nov.-Dec. 1967). (In Russian).**

Isothermal cross section of the $Th(WO_4)_2-Y_2(WO_4)_3$ system was studied in order to determine the reaction of thorium tungstates with yttrium tungstates. After annealing the mixtures at 800 to 1000°C for 10 to 15 hr it was found that a new phase was formed with small additions of $Y_2(WO_4)_3$. The x-ray phase studies of the 6 : 1 specimen showed that a high-temperature hexagonal modification was present in thorium tungstate and the diffusion of yttrium tungstate lowered the phase transition temperature. (R.V.J.)

34122 ON THE INVESTIGATION OF DOUBLE OXIDES OF UVO_5 AND UV_3O_{10}. **Efremova, O. A.; Kovba, L. M. Vestn. Mosk. Univ., Ser. II. Khim., No. 6, 85-6(Nov.-Dec. 1967). (In Russian).**

Thermal and x-ray analyses were made of the UVO_5, UV_3O_{10}, and $V_2O_5-U_2O_5$ systems. The thermal analysis data are tabulated and a diagram of the condensed state of binary system $V_2O_5-UVO_5$ was constructed. It was observed that two endothermic effects appeared in the vicinity of compositions with up to 25 mole % U_2O_5. For UV_3O_{10} three endothermic effects appeared at 795, 925, and 1025°C and for UVO_5 two endothermic effects were observed at 950 and 1135°C. (R.V.J.)

34123 STRUCTURE OF SURFACE OXIDES FORMED ON A 20 PERCENT Cr/25 PERCENT Ni/Nb-STABILISED STEEL IN CARBON DIOXIDE AT HIGH TEMPERATURES. **Francis, J. M. (Central Electricity Generating Board, Berkeley, Eng.). Brit. Corros. J., 3: 113-19(May 1968).**

Electron and x-ray diffraction studies of oxide growth on a 20% Cr/25% Ni/Nb-stabilised austenitic steel in carbon dioxide at 750 and 850° are described. The results are interpreted in terms of a duplex structure comprising an inner rhombohedral Cr_2O_3-layer and an outer spinel oxide of the $M^{2+}(M^{3+})_2O_4$ type. The influence of minor alloying elements, including rare earth metal additions, on the constitution and distribution of the surface oxide phases formed on the same basic steel is also discussed in relation to improving oxidation resistance. (auth) (UK)

34124 DETERMINATION OF DISLOCATIONS AND DISLOCATION STRUCTURES IN DEFORMED SINGLE CRYSTALS, ESPECIALLY FOR DISLOCATION DENSITIES ABOVE 10^6 cm^{-2}. **Auleytner, J. (Inst. of Physics, Warsaw). pp 201-12 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).**

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

The variation of half-width of x-ray rocking curves as a function of dislocation density determined by etching and optical observation shows a definite correlation in the range of 5×10^2 to 10^6 dislocations/cm^2. Two examples of determination of dislocation density in deformed monocrystals: CdSe and Ge in which macromosaics exist are given. An x-ray three-crystal-spectrometer and an oscillating film method were applied. The change in the dislocation density under the pressure of 0 to 600 kp/cm^2 in CdSe monocrystals was observed. Deformed Ge monocrystals change the dislocation density after neutron irradiation, (the neutron dose was 10^{18}/cm^2). (auth)

Radiation Effects

Refer also to abstracts 34092 and 34106.

34125 (EURAEC-1999) THERMAL BEHAVIOR OF CERAMIC URANIUM AND PLUTONIUM OXIDE FUELS UNDER IRRADIATION AT HIGH SPECIFIC RATINGS. Special Report No. 9. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Dec. 1967. Contract 001-64-1-TRUB. 82p. (EUR-3792). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Techniques used in fabrication and inspection of UO_2-PuO_2 fuel rods produced from sintered oxide powders are described. Results of in-pile irradiation tests conducted on the rods, in the Br-2 reactor, are reported. (P.G.C.)

34126 (NSJ-tr-102) RADIATION DAMAGE OF LOW PERMEABILITY GRAPHITE AND HARD CARBON. **Masuyama, Toshio. Translated from Nippon Genshiryoku Gakkaishi, 8: 185-94(1966). 32p.**

This report was abstracted from the original language and appeared in NSA as 20: 29822. (R.C.K.)

34127 NEUTRON IRRADIATION EFFECTS ON DIFFUSION CARBIDE AND BORIDE COATINGS ON HIGH-MELTING METALS. **Ogorodnikov, V. V.; Koval'chenko, M. S.; Krainii, A. G.; Epik, A. P. (Inst. of Problems in Material Studies, Kiev). Fiz.-Khim. Mekh. Mater., 4: 36-8(1968). (In Russian).**

Effects of neutron irradiation of carbide and boride coatings on high-melting metals were investigated. Carbide coatings cracked and boride coatings disintegrated under radiation doses of 10^{20} neutr/cm^2. The radiation resistance of the coating depended on the radiative expansion of the coating and the base. Tabulated data are given on the radiation resistance of carbide and boride coatings on niobium, molybdenum, tantalum, and tungsten. (R.V.J.)

Plastics and Other Materials

Refer also to abstracts 34007 and 35717.

34128 (BNWL-736) VISCOELASTIC EVALUATION OF SILICONE RUBBER AND ETHYLENE PROPYLENE. Gordon, N. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1968. Contract AT(45-1)-1830. 32p. Dep. CFSTI.

Initial evaluation studies were made on two materials to determine their suitability as alternates to a silicone rubber for reactor applications. Of the two materials studied, ethylene propylene and chlorosulfonated polyethylene, the ethylene propylene has the lowest compression set and stress relaxation; and consequently, appears to be the best candidate. It has a higher stress relaxation rate than the silicone but its radiation resistance is superior. (auth)

34129 (NIJS-R-517) THERMAL CONDUCTIVITY OF PITCH-BONDED GRAPHITES. Krstic, Dj.; Perme, T. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Jan. 1968. 20p. Dep.

The temperature dependence of thermal conductivity was measured for impregnated and not-impregnated pitch-bonded graphite. A dozen specimens were measured parallel or perpendicular to the extrusion plane using two different techniques: with the apparatus for the measurement of λ by the comparative heat flow method in the temperature range +30 to +265°C, and with the apparatus for the measurement of λ by the radial heat flow method in the temperature range from −182 to +405°C. The specimens have an anomalous temperature dependence of thermal conductivity. It is easily seen from the measurements that λ of the impregnated graphite has a minimum about 80°C. Such a temperature dependence of λ has not yet been described in the literature on this subject. The curves $\lambda_{||}/\lambda_{\perp} = \lambda_{||}/\lambda_{\perp}$ (T), electrical resistivity $\zeta = \zeta$ (T) and $\zeta_{||}/\zeta_{\perp} = \zeta_{||}/\zeta_{\perp}$ (T) have an anomalous behavior about 80°C. It seems that the origin of this phenomenon is the incomplete graphitization and structure of the graphite. (auth)

34130 (NP-17353) SPIN RESONANCE IN IRRADIATED PLASTICS. **Lerner, N. R. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.). Oct. 18, 1967. 42p. (LMSC-6-77-67-45). Dep. CFSTI.**

Results are presented from electron spin resonance studies performed on plastics exposed to high-dose nanosecond pulses of electrons. The principal species of free radicals produced in each plastic studied are identified, and the response of each plastic to exposure to radiation, at various dose levels as evidenced by the free radical concentration, is given. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 34307, 34687, 34918, 35129, and 35221.

34131 (AD–660897) BRIGHTNESS TEMPERATURE OF THE QUIET SUN AT CENTIMETER AND MILLIMETER WAVELENGTHS, AND CHROMOSPHERIC MODELS. Shimabukuro, F. I.; Stacey, J. M. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 20p. (TR–0158(3230-46)-1; SAMSO-TR–67-44). CFSTI.

Brightness temperature measurements of the quiet Sun are tabulated and plotted for the centimeter, millimeter, and infrared wavelengths. The measurements at centimeter and millimeter wavelengths are compared with temperatures derived from two solar models. The reported brightness temperature measurements show that a revision of chromospheric electron temperature and density estimates is needed and suggest the possibility of a temperature inversion in the chromosphere. The refinement of chromospheric models is dependent upon more accurate and higher resolution measurements at millimeter wavelengths. (auth) (USGRDR)

34132 (AD–661573) THEORETICAL RESEARCH IN ASTROPHYSICS. Final Status Report, April 1, 1965–September 15, 1967. Gold, Thomas (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). Contract AF-49(638)-1527. 20p. (CRSR–284; AFOSR–67-2614). CFSTI.

The following topics are included: (A) Theory of quasars and strong radio sources. (1) Evolution of dense star systems; (2) Dynamics of stellar collisions; (3) Light fluctuations in quasars; (4) Structure of radio sources; (5) Thermal instability due to synchrotron radiation; (6) Cosmic-ray electrons and positrons; (7) Quasars and ghost images; (8) Radiative transfer of x rays; (9) Intergalactic absorption lines. (B) Dynamics of H II regions. (1) Similarity solutions for the expansion of HII regions; (2) Stability of ionization fronts; (3) Recombination fronts in stellar wind flow; (4) Destruction of interstellar molecules; (5) Maser action in interstellar OH. (C) Stellar winds. (1) Blast waves in stellar wind flows; (2) Whistlers transonic flow in stellar winds; (3) The effect of cosmic-ray pressure gradients on the solar wind. (D) Plasma physics. (1) Nonlinear plasma oscillation. (auth) (USGRDR)

34133 (AD–661645) STUDIES OF GENERAL RELATIVISTIC EQUATIONS FOR ROTATING MATTER, AND OF COLLECTIVE EFFECTS IN GRAVITATING DISTRIBUTIONS. Final Report, July 1, 1963–June 30, 1966. Tauber, G. E.; Weinberg, J. W. (Case-Western Reserve Univ., Cleveland, Ohio). Nov. 1967. 10p. (AROD–3743:4-P). CFSTI.

The project was directed toward the solution of two outstanding problems in gravitation, the gravitational fields of rotating bodies and the collective effects of gravitation in statistical systems, i.e., galaxies of stars. (auth) (USGRDR)

34134 (AD–661959) LOW-ENERGY COSMIC RAY CUTOFFS: DIURNAL VARIATIONS AND PITCH ANGLE DISTRIBUTIONS. Paulikas, G. A.; Blake, J. B.; Freden, S. C. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 33p. (TR–0158(3260-20)-2; SAMSO-TR–67-64). CFSTI.

Observation of solar protons in the 1- to 100-MeV interval during the solar proton event of September 2, 1966, shows that: (a) an important day–night asymmetry in the geomagnetic cutoffs exists, with the flux starting to decrease from the polar plateau value at higher invariant latitudes near the noon meridian than near the midnight meridian; (b) the asymmetry is more pronounced for the lower energy particles. Direct and indirect measurements of pitch-angle distributions show that a quasi-trapped flux of protons is established at high altitudes on the dayside of the polar cap. The nonisotropic pitch angle distribution at invariant latitudes less than 75° near local noon is a manifestation of limited access of solar protons to some local times and is associated with the midday absorption recoveries observed with riometers. (auth) (USGRDR)

34135 (AD–662227) OBSERVED ABSENCE OF ENERGETIC ELECTRONS AND PROTONS NEAR VENUS. Report No. 67-66. Van Allen, J. A.; Krimigis, S. M.; Frank, L. A.; Armstrong, T. P. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Nov. 1967. Contract Nonr-1509(06). 22p. CFSTI.

The report discusses the following points: (a) The environment of Venus is almost, if not completely, devoid of energetic particles associated with the planet, as is the environment of Mars and that of the moon. (b) On the basis of physical similitude with observational and theoretical knowledge of the Earth's magnetosphere, it is concluded that the intrinsic magnetic dipole moment of Venus is certainly less than 0.01 and probably less than 0.001 of that of the Earth. Corresponding upper limits on the equatorial surface magnetic field of Venus are about 350 and 35×10^{-5} gauss, respectively. (c) The magnetofluiddynamic interaction of the solar wind with the conducting ionosphere and/or the body of Venus is too weak to generate an observable intensity of electrons having energies exceeding 45 keV. (USGRDR)

34136 (AD–663168) RADIO MEASUREMENTS OF PLANETARY NEBULAE. Report No. 1967-10. Thompson, A. R. (Owens Valley Radio Observatory, Pasadena, Calif.). 1967. Contract N00014-67-A-0094-0008. 14p. CFSTI.

Sixty-eight planetary nebulae were investigated in a series of observations at 10 cm using the two 90-ft.-diameter antennas of the Owens Valley Radio Observatory. Of these, fifty-two were found to have flux densities greater than a minimum detectable level of approximately 10^{-27} W/Hz m^2. To indicate cases of possible confusion in the radio observations, the measured radio position of each nebula was compared with an accurate optical position. For a number of the stronger nebulae angular widths in the east–west direction and flux densities in Hβ were calculated. A comparison with optical data shows values of the absorption δ log $F_{H\beta}$ ranging from zero to approximately 2.0 for NGC 6537 and NGC 6369. A small number of nebulae show prominently the effects of self-absorption in their radio spectra. Two nebulae, NGC 6369 and NGC 6857, show absorption which is probably attributable to hydrogen clouds within the galaxy. No definite evidence of absorption at frequencies near the radial velocities of the nebulae was found, and an upper limit on the mass of neutral hydrogen in two nebulae is briefly discussed. (USGRDR)

34137 (AD–663415) SOLAR X-RAY SPECTRUM BELOW 25A. Rugge, H. R.; Walker, A. B. C. Jr. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 21p. (TR–0158(9260-02)-1; SAMSO-TR–67-128). CFSTI.

A pulse-height-analyzed proportional counter and a Bragg crystal spectrometer, both mounted on a compact solar pointer, were flown on the polar, earth-oriented satellite 1966-111B and obtained solar x-ray spectra below 25 A. The crystal spectrometer yielded one highly resolved spectrum from 7 to 25 A every 250 sec. Over the observed range, much of the x-ray energy is in line radiation. The predominant lines are those of the ions N VII, O VII, O VIII, Fe XVII, Ne IX, Ne X, and Mg XI. At least 50 emission lines were observed, a number of them for the first time. Spectra taken with the crystal spectrometer under various conditions of solar activity showed that large enhancements in flux are confined to the shorter wavelength lines. The proportional counter also showed a distinct hardening of the spectrum, as well as an increase in flux with solar activity. (auth) (USGRDR)

34138 (AD–663445) GREAT BURST OF MAY 23, 1967. Environmental Research Papers No. 277. Castelli, John P.; Aarons, Jules; Michael, Glen A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Nov. 1967. 23p. (AFCRL–67-0622). CFSTI.

One of the largest radio bursts on record took place on May 23, 1967. Peak flux densities ranged between 23,000 flux units at 8800 MHz to about 370,000 units at 606 MHz. In addition to the high accuracy measurements of the peak flux densities at 606, 1415, 2695, 4995, and 8800 MHz, sweep frequency observations from 19 to 41 MHz show Type-IV emission with Type-II bursts occurring during the Type-IV continuum. The associated flare was clearly visible in white light. In reviewing and compiling microwave radio data recorded during earlier white-light flares, it was found that all but one of eight events listed by Svestka (1966) had high microwave flux densities associated with them. In comparing radio-burst intensity with optical flare importance for the series of three flares between 1809 and 2150 UT on May 23, 1967, there is only moderate agreement. The first radio burst was small; the second flare had the highest optical classification, while the third radio burst was by far the largest. The flux densities of the third radio burst may have been the highest ever recorded in the decimeter portion of the radio spectrum and among the largest four in the 8800-MHz region. It is suggested that the details of the development of the flare be followed on radio flux density plots to determine detailed correlation with particle events in space and with terrestrial effects. (auth) (USGRDR)

34139 (AD-664692) MECHANISM FOR QUASAR CONTINUUM RADIATION, WITH APPLICATION TO 3C 273B. Sturrock, P. A.; Feldman, P. A. (Stanford Univ., Calif. Inst. for Plasma Research). Dec. 1967. Contract N00014-67-A-0112-0006. 13p. (SU-IPR-215). CFSTI.

The mechanism requires a quasar model in which the central object is magnetically coupled to intergalactic space. Intergalactic plasma is accreted and flows inward, attaining supersonic speeds. The kinetic energy of this gas is converted to (relativistic) electron thermal energy at a collision-free shock front. The electron energy is rapidly radiated by the synchrotron process. The quasar 3C 273B is discussed quantitatively, and it is shown that the physical characteristics of the line-emission region and of the meter-wave radio region are consistent with those proposed for the continuum-emission region. (USGRDR)

34140 (AD-665375) SOLAR ACTIVITY: A BIBLIOGRAPHY. Eckstein, Herbert P. (Redstone Scientific Information Center, Redstone Arsenal, Ala.). Sept. 1967. 170p. (RSIC-706). CFSTI.

This bibliography contains 512 citations to articles on solar activity as evidenced by sunspots, flares, and cosmic and terrestrial effects. In addition, there are listed books dealing with solar activity, and observatory publications and other periodicals reporting routinely observational data and forecasts of periodic events. (auth) (USGRDR)

34141 (AD-665885) MARCH 1966 OBSERVATIONS OF THE GALACTIC SPUR IN THE 20 TO 40 MHz RANGE. Environmental Research Papers No. 274. Guidice, Donald A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Oct. 1967. 54p. (AFCRL-67-0546). CFSTI.

In March 1966 observations were made at the Arecibo Ionospheric Observatory to map the region of the Galactic Spur (North Polar Spur) in the 20- to 40-MHz range. Simultaneous observations were made at 38.75, 33.45, 26.70, and 22.30 MHz using a log-periodic feed, a four-way power divider, and individual null-balancing radiometers. Antenna half-power beamwidths were roughly 2.0° at 38.75 and 3.3° at 22.30 MHz. The observations were confirmed to the 2300 to 0500 local time period to minimize ionospheric effects. The area observed was between 12h and 16h right ascension, +32° and +2° declination. Results are given. (USGRDR)

34142 (AD-666948) SOLAR EVENT FORECAST AIDS. Final Report, May 1965-November 1967. Enger, Isadore (Travelers Research Center, Inc., Hartford, Conn.). Mar. 1968. Contract AF19(628)-5129. 31p. (TRC-7668-297). CFSTI.

The study describes the development of objective aids for predicting daily values of 10.7-cm flux measured at Ottawa. The step-wise regression technique was applied to 18 years of data to develop regression equations expressing flux 1, 2, 3, and 4 days ahead as functions of the past history of flux. The equations were used to compute frequency distributions of the forecast errors to be expected when the equations are applied under real-time conditions. Similar regression equations were also obtained for predicting flux 5, 6, 7, ..., 30 days ahead but no error distributions were computed. An attempt was made to improve the one- to four-day forecasts by including in the regression equations the recent history of Zurich sunspot numbers. The results were negative; flux alone did as well as flux and sunspots together. Two reports concerned with objective techniques for predicting the occurrence of solar flares were prepared previously under this contract. Abstracts of both are presented herein. Both the flare and flux techniques are being used routinely as forecast aids by the Solar Forecast Facility of the Air Weather Service. (USGRDR)

34143 (CNIE-PE-8) SOLAR PHYSICS. Schatzman, Evry (Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina)). 1965. 63p. Dep.

This report contains a short course on solar physics given at the 6th Meeting of the Latin American School of Physics held at Tucumán, Argentina in July 1964. Topics covered include the Sun as a star, physical conditions in the outer layers of the Sun, motions in the solar atmosphere, active regions, and solar flares. (W.D.M.)

34144 (TID-24491, pp 19-22) LONG-BASELINE INTERFEROMETER EXPERIMENTS. Moran, J. M.; Barrett, A. H.; Burke, B. F. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Spectra are given for the W3 radio source. (M.O.W.)

34145 (UCRL-71080) STATISTICAL MECHANICS OF DENSE IONIZED GASES. DeWitt, Hugh E. (California Univ., Livermore. Lawrence Radiation Lab.). May 14, 1968. Contract W-7405-eng-48. 19p. (CONF-680317-1). Dep. CFSTI. From Conference on Low Luminosity Stars, Charlottesville, Va.

Coulomb interactions in dense partially ionized gases are discussed. Results of quantum mechanical perturbation expansions in statistical mechanics of ionized gases are described. (M.O.W.)

34146 SECOND APPROACH TO COSMICAL ELECTRODYNAMICS. Alfven, H. (Royal Inst. of Tech., Stockholm). Ann. Geophys., 24: 341-6(Jan.-Mar. 1968).

A review of "the first approach" to cosmical electrodynamics shows that at the development of this field of science some of the basic concepts have been misleading. In three different respects a revision is necessary: 1. Homogeneous models have been used even in cases where filamentary structure, microspots, or other small-scale inhomogeneities makes such models inadequate even as a first approximation. 2. The electric conductivity parallel to the electric field has been put equal to infinity in a number of cases when this is not legitimate. There is a number of different effects which may produce electric fields parallel to the magnetic field. A consequence of this is that the "frozen-in" picture of magnetic field lines is not always applicable. 3. It is important to draw not only the magnetic-field picture but also the current-line picture. The general importance of electric currents in the cosmos is stressed and some examples discussed. Filamentary structure may be caused by electric currents. Solar flares may be understood as a sudden release of energy by the disruption of an electric current. (auth)

34147 DETERMINATION OF THE GALACTIC ROTATION CONSTANT A BEGINNING WITH 52 O, B, A STARS. Barbier, Madeleine (Observatoire de Marseille. Observatoire de Haute Provence, France). Compt. Rend., Ser. A and B, 266: 885-6 (Mar. 25, 1968). (In French).

The value of the galactic rotation constant A was calculated by using the radial velocities measured with the Fehrenbach objective prism of 52 O, B, A stars in the Cassiopeia constellation. The value obtained was $A = 16.0 \pm 2.2$ km · sec^{-1}. (tr-auth)

34148 DYNAMICAL TIDES IN CLOSE BINARY SYSTEMS. II. CENTRALLY CONDENSED MODELS. Kopal, Zdenek (Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 284-300(1968).

An attempt is made to deduce the explicit form of differential equations which govern dynamical tides in close binary systems, with simplifications which are permissible for the mass-point model, as well as for one exhibiting finite but high internal density concentration. It is pointed out that, whereas the exact formulation of the problem leads to a simultaneous system of equations of sixth order (fourth in the inviscid case), this order reduces to four (or two for inviscid fluids) for the mass-point model; and to five (three for inviscid case) if the density concentration is high but finite. The coefficients $C_{i,j}$ which specify the amplitudes of the individual partial tides are explicitly formulated as functions of the time. (auth)

34149 FURTHER IMPULSIVE EMISSION FROM CP 0950. Rickett, B. J.; Lyne, A. G. (Univ. of Manchester, Eng.). Nature (London), 218: 934-5(June 8, 1968).

During observations of the polarization of the impulsive emission from CP 0950 a further feature of the previously reported profile (Nature, 218: 124 and 326(1968)) became apparent. The presence of impulsive emission in the region between the main pulses was indicated. The mean profile obtained at 408 MHz using the Mark I telescope is shown; the newly discovered "interpulse" is shown to lie 100 ms before the peak of the main pulse. This interpulse was found to be very highly polarized. Measurements were also made with two receivers connected to orthogonal dipoles at the focus of the telescope, and the results of 50 min simultaneous integration on the interpulse on the two orthogonally polarized receivers are shown. It was estimated that the interpulse has 85 to 100% of its radiation at 408 MHz linearly polarized, while the peak of the main pulse was only about 15% linearly polarized. The duration of the interpulse was about the same as that of the main pulse, and the energy was about 1.8% of that in the main pulse. Similar results were obtained at 151 MHz. No similar emission for CP 1133 and 1919 was found. The origin of the interpulse is discussed. It is suggested that there are two emitting regions separately excited by related shock fronts. (UK)

34150 WHITE DWARFS AND TYPE-I SUPERNOVAE. Baglin, A. (Institut d'Astrophysique, Paris). Astrophys. Lett., 1: 143-4(March 1968).

The explosion of a white dwarf leading to a type-I supernova is discussed. It is shown that it is most probably due to the general relativistic correction studied in Baglin (1966) and not to electron captures as suggested by Finzi and Wolf (1967). (auth)

34151 INFLUENCE OF THE PLANET MERCURY ON SUNSPOTS. Bigg, E. K. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astron. J., 72: 463-6(May 1967). (RPP-999).

The Zürich relative daily sunspot numbers for the years 1850 to 1960 are shown to contain a small but consistent periodicity at the sidereal period of the planet Mercury. The heliocentric position of any one of the planets Venus, Earth, or Jupiter changes the amplitude of this Mercury effect, each in much the same way. It is concluded that forces of extrasolar origin have at least some influence on the formation or disappearance of sunspots. (auth)

34152 INFLUENCE OF THE MAGNETOACTIVE PLASMA ON GYRO-SYNCHROTRON EMISSION SPECTRA IN THE SOLAR ATMOSPHERE. Sakurai, Kunitomo; Ogawa, Tadahiko (Kyoto Univ.). Kakuyugo-Kenkyu, 20: 355-82(Mar. 1968). (In Japanese).

The influence of a magnetoactive plasma on the gyro-synchrotron emission from an accelerated electron is considered in detail. This influence for the right-handed waves is comparable with that for the left-handed waves. The radiated intensity of both the right- and left-handed waves is generally smaller than that in vacuum, but the former occasionally become much higher within some special frequency range compared with the latter. Solar radio type-IV bursts are emitted due to the interaction of sunspot magnetic fields with energetic electrons moving in the solar atmosphere. Accordingly, the influence of solar atmospheric plasmas on the bursts is examined. Some investigations are made of this influence on the emission of the bursts, based on the estimation of both the intensity of sunspot magnetic fields and the plasma density in the flare regions. The spectral pattern of type-IV radio bursts is briefly considered. (auth)

34153 EXTENT OF THE RADIO EMISSION FROM M31. Dickel, J. R. (Univ. of Illinois Observatory, Urbana). Astrophys. Lett., 1: 133-7(March 1968).

A series of observations at 750 and 1400 MHz have been made of the Andromeda Galaxy M31 with the 300-foot radio telescope at the National Radio Astronomy Observatory. These include drift curves and scans along the optical major axis. The observations suggest that there is no symmetrical halo of emission around M31 although there may be some extended, irregularly shaped emission features associated with the galaxy. (auth)

34154 NEW DEVELOPMENTS IN COSMOLOGY. Kafka, Peter (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Sterne Weltraum, 7: 64-9(Mar. 1968). (In German).

Progress achieved in cosmology during the past few years, based on the developments in radio astronomy and information obtained from satellites and rocket soundings, is discussed. Theoretical considerations concerning the expansion of the Universe lead to speculations concerning the nature of the expansion of radio galaxies. The importance of quasars for modern cosmology is demonstrated. (IAA)

34155 BRANS–DICKE COSMOLOGY. Greenstein, G. S. (Yale Univ., New Haven, Conn.).. Astrophys. Lett., 1: 139-41 (March 1968).

The cosmological implications of the Brans–Dicke scalar–tensor theory are discussed. It is found that if the universe is open, the present value of $(-\dot{G}/G)$ is quite small, and the primordial abundances of D, ^{3}He, and ^{4}He are equal to their general relativistic values. Closed models give large but not impossible values of $(-\dot{G}/G)$, but the primordial ^{4}He abundance may be too high. (auth)

34156 ABUNDANCE OF MOLECULAR HYDROGEN IN INTERSTELLAR GAS CLOUDS. Mendis, D. A. (Univ. of Manchester, Eng.). Astrophys. Lett., 1: 129-32(March 1968).

A new estimate of the H_2 abundance in neutral interstellar clouds, on the basis of the chemical exchange reaction between interstellar hydrogen atoms and hydrogen atoms chemically bound to interstellar grains shows that an average cloud contains about 25% H_2 by mass. This is only about one-third the previous estimate. Also a firm upper limit of about 33% is indicated for any cloud in contrast to the earlier calculation, which allowed for clouds that were almost fully molecular. (auth)

34157 EFFECT OF COLLISIONS ON THE IONIZATION EQUILIBRIUM OF A LOW DENSITY PLASMA. Dupree, A. K. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett., 1: 125-8(March 1968).

Under certain conditions, collisional ionizations from high atomic levels are found to reduce the fractional concentration of atoms in a given stage of ionization in a low density plasma. For ions of relatively low charge in the solar corona, the ionization equilibrium becomes dependent on the electron density. (auth)

34158 ISOTOPIC COMPOSITION OF DIFFERENT PHASES OF CARBON IN CARBONACEOUS METEORITES. Vinogradov, A. P.; Kropotova, O. I.; Vdovykin, G. P.; Grinenko, V. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow. All-Union Inst. of Mineral Resources, Moscow). Geochem. Int. (Engl. Transl.), 4: 229-35(1967).

Translated from Geokhimiya, No. 3, 267-73(1967).

The isotopic composition of various carbon phases (graphite, diamond, organic matter) and of the bulk carbon of some meteorites has been investigated. The δ^{13}C value of the bulk carbon in the investigated meteorites ranges from –0.71 to –2.07% (standard PDB). A correlation between the isotopic composition of carbon and the degree of meteorite enrichment in carbon has been noted. It is shown that for the organic matter of meteorites, δ^{13}C varies from –2.20 to –2.87%, and for graphite, from –0.5 to –0.63%. In the ureilite Novyy Urey the isotopic compositions of graphite (δ^{13}C, –0.63%) and of diamond (δ^{13}C, –0.37%) are near each other; this does not contradict the idea of an impact mechanism of diamond formation in ureilites. The isotopic data on carbon confirm the genetic relation of ureilites in carbonaceous meteorites. (auth)

34159 ON THE REDDENING LINES OF THE CEPHEIDS ON THE U–B/B–V DIAGRAM. Nikolov, N. S. (Astronomical Inst., Sofia). Astrophys. Lett., 1: 151-2(March 1968).

The reddening line for Cepheids was obtained on the basis of the U – B and E – V colors for 170 Cepheids at maximum light. (auth)

34160 MISUNDERSTANDING ABOUT THE SYNCHROTRON EMISSIVITY FOR THE COSMIC AND PLANETARY RADIO WAVES. Takakura, T.; Uchida, Y. (Tokyo Univ.). Astrophys. Lett., 1: 147-9(March 1968).

It is pointed out that the expression currently used for the emissivity of synchrotron emission from helically moving high-energy electrons should be multiplied by $(\sin\theta)^{-2}$, where θ is the angle between the magnetic field and the line of sight. This correction seriously modifies the interpretations of the intensity steps in the Galactic nonthermal radio emission and the beaming of the Jupiter's decimetric waves. (auth)

34161 XENON AND KRYPTON ISOTOPES IN SOME STONY METEORITES. Gerling, E. K.; Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Komarov, A. N.; Tolstikhin, I. N. (Lab. of Precambrian Geology, Leningrad). Geochem. Int. (Engl. Transl.), 4: 338-49 (1967).

Translated from Geokhimiya, No. 4, 387-98(1967).

An enrichment in ^{136}Xe, which may be accounted for by ^{244}Pu fission, has been found in a black fraction of the enstatite chondrite Kunashak and in the magnetic fractions of the hypersthenic meteorite Saratov and of the crystalline chondrite Elenovka. The meteoritic Kr is enriched in ^{86}Kr, ^{83}Kr, and ^{82}Kr relative to ^{84}Kr. This effect is caused by reactions due to cosmic-ray irradiation. Tracks of nuclei with great mass and energy have been detected in meteorites. There is anisotropy in the track direction. (auth)

34162 VARIATIONS OF THE SPECTRUM OF THE NUCLEUS OF THE SEYFERT GALAXY NGC 3516. Andrillat, Y. (Faculte des Sciences, Montpellier, France); Souffrin, S. Astrophys. Lett., 1: 111-19(March 1968). (In French).

A detailed description of the continuum and line spectrum of the nucleus of NGC 3516 is given. Since 1943, the date of the only published observation, the Balmer lines have almost disappeared, and the forbidden lines seem intensified. These variations are interpreted by the injection of dense matter, expanding and becoming less dense, and also with the injection of ultra relativistic electrons emitting ultraviolet synchrotron radiation which ionizes the dilute gas already present before the explosion. (auth)

34163 THE STRUCTURE OF THE RADIO SOURCES 3C79 AND 3C192. Gulkis, S.; Hazard, C.; Bray, A. D. (Arecibo Ionospheric Observatory, Puerto Rico). Astrophys. Lett., 1: 105-10(March 1968).

The structure of the radio sources associated with the radio galaxies 3C 79 and 3C 192 as derived from occultation observations with the 1000-ft radio telescope at Arecibo, Puerto Rico is discussed. The source associated with 3C 79 exhibits the familiar two-component structure of the majority of radio galaxies with the optical object lying between the two radio components, while 3C 192 has an unusual structure for a radio galaxy being highly elongated and apparently containing three or more emitting regions along its major axis. Both sources are about 160 kpc in extent, a typical size for a source associated with a radio galaxy. However, while 3C 192 also has a typical total emission of about 1.4×10^{42} erg sec^{-1}, 3C 79 has an emission of about 3×10^{43} erg sec^{-1}, which makes it one of the most intense emitters of the identified radio sources, with a luminosity comparable to that of quasi-stellar radio sources rather than that of typical radio galaxies. (auth)

34164 INTERNAL MOTIONS IN NGC 6853, 6618, AND 1976. Sheglov, P. V. (Sternberg Astronomical Inst., Moscow). Astrophys. Lett., 1: 145-6(March 1968).

An interferometric study of several diffuse nebulae and NGC 6853, using a modified Fabry–Perot etalon, is described. All three nebulae were observed in an interval of radial velocities of ±120 km/sec relative to the Sun. The bright parts of all three nebulae were seen in all the velocity intervals examined. The charge of shape as a result of shifting the velocity interval is much more pronounced for NGC 6618 and 1976 than for NGC 6853. (W.D.M.)

34165 COMMENTS ON SEATON'S DISTANCE SCALE FOR PLANETARY NEBULAE. Gordon, C. (Pecker-Wimel) (Goddard Space Flight Center, New York). Astrophys. Lett., 1: 121-3 (March 1968).

Because of the uncertainties involved in the determination of the mass of a planetary nebula, it is difficult to determine accurately if the beginning of the evolutionary track of the central stars in the diagram log $(L/L_\odot)$, log T is an ascending branch to a line of almost constant luminosity. (auth)

34166 OPTICAL SEARCH FOR PULSATIONS FROM PULSATING RADIO SOURCE CP 1919. Papaliolios, C (Smithsonian Astrophysical Observatory, Cambridge, Mass); Carleton, N. P.; Horowitz, P.; Liller, W. Science, 160: 1104-5(June 7, 1968).

Optical observations of the 18th magnitude blue star and of the faint red object in the approximate location of the pulsating radio source CP 1919 disclose no pulsations of visible light, in a mode similar to that of the radio pulsations, of more than 0.4 or 0.8%, respectively, of the total visible output; or, for a sinusoidal modulation with the same period, no more than a 4-, or 8-%, root-mean-square intensity fluctuation. (auth)

34167 VARIATION OF THE ANGULAR SIZES OF QUASARS WITH REDSHIFT. Miley, G. K. (Univ. of Manchester, Eng.). Nature (London), 218: 933-4(June 8, 1968).

Evidence for the existence of a relation between redshift and magnitude of quasars with flat spectra has been put forward by other authors. In the present communication some studies employing the Mark I telescope at Jodrell Bank and the Mark III telescope at Wardle are described. These instruments were used as elements of a long baseline interferometer at a frequency of 408 MHz, giving a baseline of length ~32,000 wavelengths. Fringe visibility measurements were made on 72 quasars with known red shifts. Values of visibility are shown plotted against red shift, with a distinction between quasars with spectral indices >0.7 and those with flat and curved spectra. There appears to be evidence that for quasars with steep spectra those with low red shifts have comparatively large angular dimensions. Results are also illustrated in histogram form. Of 21 quasars with red shifts <1 only one had a visibility >0.5, whereas of the 18 with red shifts >1 nine had visibilities >0.5. The difference between the mean visibilities of these two sub-groups was 0.28 ± 0.08, which provides strong evidence that the mean angular dimensions of these quasars decrease with increasing red shift. To explain the observed behavior each quasar is assumed to be a double radio source, with components having identical structure. The visibility at a given resolution for a particular source is then governed by the separation, position angle, and flux ratio of the double. A decrease of angular size with red shift is clearly to be expected if the red shifts are cosmological, and angular diameter promises to be a very useful parameter in testing model universes. The effect of frequency dependence, however, must be considered. (UK)

34168 INTERESTING MANIFESTATION OF THE SUNSPOT CYCLE IN ATMOSPHERIC CIRCULATION. Abramov, R. V. (Inst. of Oceanology, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 456-8(1967).

Translated from Geomagn. Aeron., 7: 561-3(1967).

Variations in the geographic position and intensity of the Icelandic low are examined in conjunction with solar activity. (W.D.M.)

34169 DENSITY PERTURBATIONS IN COSMOLOGICAL MODELS. Field, George B.; Shepley, L. C. (Univ. of California, Berkeley). Astrophys. Space Sci., 1: 309-35(1968).

Differential equations are derived, following the methods of Lifshitz (1946) and Lifshitz and Khalatnikov (1963), for density perturbations in isotropic, spatially homogeneous cosmological models of arbitrary space curvature. The unperturbed models contain both matter and radiation. An explicit third-order equation is obtained for the time development of the perturbations, and it is shown that one of the solutions is not convariantly defined The two remaining solutions are compared with existing solutions for the limiting cases of radiation-filled and dust-filled models. The results of Bonnor's (1957) Newtonian analysis are shown to be a valid limiting case of the equation when the pressure p is finite, but small compared with the density ρ times c^2. A detailed analysis is given of a model containing coupled radiation $(p = \rho c^2/3)$ and dust $(p = 0)$. It is shown that density perturbations with long wavelengths are unstable (with slow growth rate) for all time. The instability exists because for a long-wavelength disturbance, the time scale governing the propagation of pressure effects (which stabilize perturbations) is longer than the time scale for which pressure falls to the point of ineffectiveness. The present value of the critical wavelength is ~60 Mpc in models based on flat space sections in which the present background radiation temperature is 3°K. (auth)

34170 NEUTRINOS IN NEUTRON STARS. Vilhu, Osmi (Univ. of Helsinki). Astrophys. Space Sci., 1: 301-8(1968).

It is shown that in neutron stars some of the neutrinos cannot escape from the star. For incompressible fluid sphere models, this part, in the optimum case, is 25%, and for the model V_γ(B) integrated by Tsuruta and Cameron (1966b) 1%. As a result a neutrino sea is formed and some radioactive isotopes may become stable. (auth)

34171 AN INVESTIGATION OF A PECULIAR NEBULA IN MONOCEROS. Meaburn, J. (Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 278-83(1968).

A faint nebula, between the Rosette and NGC 2264, appears to be supernova remnant. This was photographed with long exposures through narrow filters centered on the bright nebular emission lines. Interferograms were also taken. These revealed extensive regions emitting broad lines, and showed that the nebula did not have the large expansion velocity that was expected. (auth)

34172 THE DYNAMICS OF THE ORION NEBULA. I. NEUTRAL CONDENSATIONS IN AN H II REGION. Dyson, J. E. (Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 388-405(1968).

A model is constructed of a spherically symmetric self-gravitating condensation of neutral hydrogen immersed in an H II region The structure of the condensation is represented by the isothermal gas sphere at a temperature of 100°K. Typical parameters of such a condensation compatible with the estimated ultraviolet radiation field in the central regions of the Orion Nebula are, mass $\approx 1 M_\odot$; radius $\approx 10^{16}$ cm; mean density $\approx 10^{-15}$ gm cm^{-3}. The condensations are not static configurations but evolve because of mass loss by ionization from their surfaces. Perhaps 5% become gravitationally unstable and collapse. The remainder act as sources of ionized gas which flows into the surrounding nebula. (auth)

34173 HYDROGEN AND HELIUM ABUNDANCES IN NEUTRON-STAR ATMOSPHERES. Rosen, Leonard C. (Univ. of California, Livermore. Goddard Space Flight Center, Greenbelt, Md. Columbia Univ., New York). Astrophys. Space Sci., 1: 372-87(1968).

An analysis is presented of the burning and diffusion of hydrogen and helium in a neutron-star atmosphere. An initial two-component atmosphere of hydrogen and carbon and of helium and carbon is examined utilizing various photospheric temperatures. The hydrogen burns through the proton–proton reaction and the CN cycle and the helium by the triple-alpha process and alpha capture on carbon. It is found that only a negligible proportion of hydrogen or helium can exist after a few years in the neutron-star atmosphere. (auth)

34174 GROUP-THEORETICAL ASPECTS OF THE STUDY OF NONRADIAL OSCILLATIONS. Perdang, J. (Univ., Liege). Astrophys. Space Sci., 1: 355-71(1968).

Group-theoretical techniques were used for the analysis of nonradial oscillations of spherical stars, for the classification and the study of the splitting of the modes under the influence of rotation, tides and magnetic fields, as well as for ellipsoidal configurations. The general conclusions are compared with the analytical and numerical results which have up to now been worked out only for artificial models. (auth)

34175 NUCLEAR BURNING STABILITY AND THE LIMITATION OF "THERMAL RUNAWAYS." Rakavy, G. (Hebrew Univ., Jerusalem); Shaviv, G. Astrophys. Space Sci., 1: 347-54(1968)

Conditions are stated under which the nuclear reaction rates cease to increase after a "thermal runaway" has occurred. The mechanism by which a nuclear power surge is limited and terminated is investigated. (auth)

34176 EVOLUTION OF BINARY SYSTEMS WITH REPEATED MASS EJECTIONS. Hadjidemetriou, John D. (Thessaloniki Univ., Greece). Astrophys. Space Sci., 1: 336-46(1968).

The effects of a series of isotropic ejections of small amounts of mass from either component of a binary system are studied. The evolution is completely different than in the case where all the mass is lost at once. When the ejections are randomly distributed in time, the final eccentricity may become larger or smaller than the initial one; the differences, however, are in most cases small. When the frequency of the explosions is higher near periastron, the final eccentricity is in most cases larger than the original value. In almost no case is the system disrupted. (auth)

34177 ENIGMATIC NOVA DELPHINI. Hindley, Keith (Liverpool Univ.). New Sci., 38: 468-71(May 30, 1968).

It is stated that the inconspicuous star which blazed into prominence in the constellation Delphinus in July 1967 continues to be one of the most unpredictable and fascinating novae of this century. (auth) (UK)

34178 AMPLITUDE VARIATIONS IN PULSED RADIO SOURCES. Scheuer, P. A. G. (Univ. of Cambridge, Eng.). Nature (London), 218: 920-2(June 8, 1968).

Refraction by irregularities in the interstellar medium may cause the long period fluctuations in the amplitudes of radio signals from the pulsed sources. (auth) (UK)

34179 OSCILLATIONS OF HAMADA-SALPETER WHITE DWARFS INCLUDING GENERAL RELATIVISTIC EFFECTS. Skilling, J. (Univ. of Cambridge, Eng.). Nature (London), 218: 923-4(June 8, 1968).

When general relativistic effects are included in certain models of white dwarfs, it seems impossible to obtain radial oscillation periods appreciably shorter than 2 s. (auth)

34180 ON CORRELATIONS BETWEEN BRIGHTNESS, VELOCITY, AND MAGNETIC FIELDS IN THE SOLAR PHOTOSPHERE. Livingston, W. C. (Kitt Peak National Observatory, Tucson, Ariz.). pp 61-72 of Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Vol. III. Physical Sciences and Engineering. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967.

See CONF-650679-(Vol.3).

The available observational data on velocity and brightness fields are outlined. Consideration is restricted to the lowest atmospheric level, the photosphere, and also to aspects of the normal or "quiet" Sun. Additional new, and preliminary, observations on the relation of (longitudinal) magnetic fields to the V and I structure are given. The preliminary nature of this new data is emphasized because the effective image resolution is uncertain, and it is difficult to say how the fine detail is attenuated. (W.D.M.)

34181 SPACE DISTRIBUTION OF SMALL DARK NEBULAE. Lynds, Beverly T. (Univ. of Arizona, Tucson). pp 51-60 of Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Vol. III. Physical Sciences and Engineering. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967.

See CONF-650679-(Vol.3).

The National Geographic Society—Palomar Observatory Sky Atlas has been used to compile a catalog of dark nebulae. In this catalog the galactic coordinates, projected surface areas, and estimates of the opacities of the clouds are listed. The most opaque clouds are designated by opacity 6. These objects were selected on the condition that no stars were visible within the measured surface area of the cloud. This paper deals only with the distribution of the opacity-6 clouds, and an attempt is made to reproduce the observed distribution of apparent sizes of these objects by a simple model. (W.D.M.)

34182 MASSES OF GALAXIES: SINGLES AND MEMBERS OF MULTIPLE SYSTEMS. Page, Thornton (Wesleyan Univ., Middletown, Conn.). pp 31-49 of Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Vol. III. Physical Sciences and Engineering. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967.

See CONF-650679-(Vol.3).

The masses of galaxies are important in several areas of astronomy and physics. In cosmology the mean mass is used to derive the average density of matter in the Universe, a quantity which is related to the curvature of space in the cosmological models of general relativity. Masses of single galaxies, mean masses in pairs of galaxies, masses and stability of clusters of galaxies, and evolution of galaxies are discussed. (W.D.M.)

34183 AGE DISTRIBUTION OF GALAXIES. McCrea, W. H. (Univ. of Sussex, Eng.). pp 19-29 of Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Vol. III. Physical Sciences and Engineering. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967.

See CONF-650679-(Vol.3).

This paper is concerned with the two questions: how might the large-scale study of the Universe assist the study of the evolution of individual galaxies, and how might a knowledge of the evolution of individual galaxies assist the large scale study of the Universe, particularly in regard to the choice between evolutionary and steady-state cosmologies? First, certain simple general results concerning ages of galaxies in known cosmological models are brought together, and then the observational results for the actual Universe are discussed. (W.D.M.)

34184 EVOLUTION OF GALAXIES. Burbidge, E. M.; Burbidge, G. R. (Univ. of California, San Diego). pp 1-18 of Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Vol. III. Physical Sciences and Engineering. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967.

See CONF-650679-(Vol.3).

An attempt is made to describe and review recent ideas and work on the evolution of galaxies. The evolution of a rotating gaseous protogalaxy is briefly considered. Other topics discussed include arguments against an evolution Irr → Sc → Sb → Sa → SO, the problem of large M/L ratios (need to abandon postulate) of a universal luminosity function, constant galactic mass, and particular objects and particular aspects of galaxies. (W.D.M.)

34185 ICARUS: FURTHER CONFIRMATION OF THE RELATIVISTIC PERIHELION PRECESSION. Shapiro, Irwin I.; Ash, Michael E.; Smith, William B. (Massachusetts Inst. of Tech., Lexington). Phys. Rev. Lett., 20: 1517-18(June 24, 1968).

The non-Newtonian perihelion precession for the asteroid Icarus was deduced from optical observations and found to agree with the predictions of general relativity to well within the estimated uncertainty of 20%. If observations are made June, 1968 when Icarus passes close to the Earth, this uncertainty could be reduced to 8%. With such new data a marginally useful bound could also be placed on the quadrupole moment of the sun's gravitational field. (auth)

34186 SEARCH FOR OPTICAL FLASHES FROM THE RADIO SOURCE CP 1919. Jelley, J. V. (Atomic Energy Research Establishment, Harwell, Eng.); Willstrop, R. V. Nature (London), 218: 753-5(May 25, 1968).

The four rapidly pulsating radio sources discovered by Hewish et al. have been tentatively identified with neutron stars or white dwarfs, and their optical identification is therefore of great interest. An accurate position of the source CP 1919 has been determined by Ryle and Bailey, and includes a yellow object of magnitude about B = 19; radio measurements of position strongly favor identification of CP 1919 with the yellow object. A search was made for brightness fluctuations of all objects in two small areas of the sky centered on the yellow object, at the same periodicity as the radio fluctuations. No brightness fluctuations with a period of 1.3372 s were detected. Observations were made with the Cambridge Observatory's 92-cm reflecting telescope, and the technique employed is described in detail. The evidence neither confirms nor refutes identification of CP 1919 with the yellow object, but may help to elucidate some of its properties. (UK)

34187 ROTATING NEUTRON STARS AS THE ORIGIN OF THE PULSATING RADIO SOURCES. Gold, T. (Cornell Univ., Ithaca, N. Y.). Nature (London), 218: 731-2(May 25, 1968).

The constancy of frequency in the recently discovered pulsed radio sources can be accounted for by the rotation of a neutron star. Because of the strong magnetic fields and high rotation speeds, relativistic velocities will be set up in any plasma in the surrounding magnetosphere, leading to radiation in the pattern of a rotating beacon. (auth) (UK)

34188 SOME MODELS FOR PULSED RADIO SOURCES. Pacini, F.; Salpeter, E. E. (Cornell Univ., Ithaca, N. Y.). Nature (London), 218: 733-4(May 25, 1968).

The case of a satellite orbiting around a neutron star is discussed. This appears to be a very unlikely explanation for the pulsating radio sources. (auth) (UK)

34189 STABILITY AND RADIAL VIBRATION PERIODS OF THE HAMADA-SALPETER WHITE DWARF MODELS. Faulkner, John; Gribbin, John R. (Univ. of Cambridge, Eng.). Nature (London), 218: 734-6(May 25, 1968).

The rapidly pulsating radio sources may, after all, be vibrating white dwarfs. Calculations show that fundamental vibration periods for white dwarfs can be as low as ~1.5 s. (auth)

34190 GENERAL RELATIVISTIC INFLUENCE ON OBSERVED PULSAR FREQUENCIES IF PULSARS ARE ORBITING OBJECTS.

Hoffmann, B. (City Univ. of New York, Flushing). Nature (London), 218: 757(May 25, 1968).

It has been pointed out that pulsars might provide a means of making a new test of the general theory of relativity by providing a stable extraterrestrial frequency standard against which the differential general relativistic effect on terrestrial clock rates at perihelion and aphelion could be measured. The purpose of the present communication is to indicate what could be an important analogous effect should pulsars prove to be orbiting bodies. (UK)

34191 MODEL FOR PULSED RADIO SOURCES. Israel, W. (Dublin Inst. for Advanced Studies). Nature (London), 218: 755-6(May 25, 1968).

It is possible, independently of any particular model, to draw sharp and significant conclusions from the recently obtained observational data on pulsed radio sources. Radiation from all four sources is strongly polarised, and hence is definitely of snychrotron origin. There is also evidence that all the radio emission originates from a very light shell. A remarkable finding is the unprecedented sharpness of the pulses. It seems virtually impossible to reconcile the pulse shape with any continuous oscillation of the source; the observations rather suggest some sort of "clockwork mechanism" which triggers short impulses (≈30 ms) separated by comparatively long intervals (≈1s) of quiescence. The precise regularity of the signals indicates a delicate balance of the "clockwork", and its great stability in face of the violent fluctuations in pulse amplitude must mean that it is energetically decoupled from the radio source or that it is controlled by an energetic process of a much higher order of magnitude. The model proposed is that of a neutron star on the edge of gravitational instability, with a short period "astronomical sand-glass" "clockwork" mechanism. The observed pulse width is determined by the synchrotron decay time and not by the size of the source. The fact that CP 0950, with a very small pulse width, appears to have an unusually strong magnetic field tends to support this conclusion. The scale of the pulsar mechanism must be regulated by a small supply of accreted material from the interstellar medium. On the basis of the proposed model a number of predictions concerning pulsars, both qualitative and quantitative, are made; most interesting is the possibility of detecting them as x-ray sources, the most favorable case being CP 0950. Radiation at optical wavelengths would be negligible on the model. It is suggested that the pulsar condition is a natural stage in the evolution of supernovae remnants. The lifetime of a pulsar is also briefly considered. It is finally suggested that there may exist in the galaxy a comparatively large number of radio-quiet pulsars, which are nevertheless fairly powerful x-ray sources. (UK)

34192 CORRELATION BETWEEN SOLAR ACTIVITY AND THE BRIGHTNESS OF JUPITER'S GREAT RED SPOT. Graf, E. R.; Smith, C. E.; McDevitt, F. R. (Auburn Univ., Ala.). Nature (London), 218: 857(June 1, 1968).

It is stated that a correlation between solar activity likely to affect the uv radiation in the solar system and the activity of the Jovian great red spot would be of some significance to interest in the planet. Such a correlation with brightness was observed. (UK)

34193 UPPER LIMIT ON X RAYS FROM A NEW SUPERNOVA. Bradt, H. (Massachusetts Inst. of Tech., Cambridge); Naranan, S.; Rappaport, S.; Zwicky, F.; Ogelman, H.; Boldt, E. Nature (London), 218: 856-7(June 1, 1968).

Knowledge of the intensity of x radiation from the early stages of a supernova is important to an understanding of the processes which occur during the outburst. A comparison was made of the celestial positions and times of occurrence of recently reported supernova outbursts with recent sky surveys at x-ray wavelengths, with particular reference to the new supernova SN 1967 h in NGC 4254. The upper limit to the x radiation between 1.5 and 6 keV was found to be $R < 0.02$ counts/cm^2/sec. The ratio of this limit to the optical luminosity, at an age of <34 days, is about eight times the observed ratio for the Crab nebula (a supernova remnant of age ~900 yr.). (UK)

34194 UPPER LIMIT TO RADIO EMISSION FROM NOVA DELPHINI 1967. Andrew, B. H.; Purton, C. R. (National Research Council, Ottawa). Nature (London), 218: 856(June 1, 1968).

Attempts were made to detect radio emission from the nova at a wavelength of 4.6 cm., using the 46m Algonquin Observatory radio telescope, at a time when the visual magnitude was ~5.0. The measured flux density was 0.006 ± 0.012 flux units, indicating an upper limit of 0.02 flux units (1 flux unit = 10^{-26}W/m^2/Hz). (UK)

34195 DETECTION OF RADIO EMISSION FROM SCORPIO X-1. Andrew, B. H.; Purton, C. R. (National Research Council, Ottawa). Nature (London), 218: 855-6(June 1, 1968).

Previous attempts to detect radio emission from Sco X-1, which is the strongest x-ray source, yielded only upper limits to its flux density. In the studies described, the flux density was measured as 0.021 ± 0.007 flux units (1 flux unit = 10^{-26} W/m^2/Hz) at a wavelength of 4.6 cm., using the 46-m Algonquin Observatory radiotelescope. The possible effects of "confusion" were considered. Radio, optical, and x-ray measurements of Sco X-1 are compared. It is shown that the emission cannot be explained in terms of a simple thermal model. It has been pointed out that the x-ray spectrum could be due to synchrotron emission if the corresponding electron energy spectrum has a high-energy cutoff. This interpretation is compatible with the observed data if the electron energy spectrum is of the form $N(E) \cdot dE \propto E^{-0.8} \cdot dE$ and has a high-energy cutoff corresponding to an emission frequency of 10^{18} Hz. (UK)

34196 SOLAR ASTRONOMY IN THE X BAND. Tagliaferri, G. L. (Osservatorio Astrofisico di Arcetri, Florence). Scientia (Milan), 102: 519-24(Nov. 12, 1967). (In Italian).

Observational results completed at the end of 1966 in x-ray solar astronomy are reported. Data are reviewed in particular with respect to space vehicles—balloons, rockets, and satellites—and qualitative descriptions of spectral, spatial, and temporal resolution are given. The history of x-radiation measurements by space vehicles is reviewed. The x-ray spectrum of the Sun has three origins: the bremsstrahlung process, an emission of energy by retardation of electrons in the field of protons, producing a continuous spectrum; the combination of electrons with ionized atoms, again producing a continuous spectrum; and an excitation process in atoms or ions by electron impact, producing a line spectrum. Theoretical calculations of intensities, based on temperature, electron density, and so forth, are in agreement with observed results. (BBB)

34197 SOLAR ACTIVITY. Scotti, H. (Sonnenobservatorium Kanzelhoehe, [Austria]). Wetter Leben, 19: 295-6(1967). (In German).

Provisory sunspot relative numbers for July and August 1967 published by the Federal Observatory in Zurich are tabulated. Solar activity was low until 22 July and then increased sharply; the mean spot relative number was 40% greater than June, 87.8. Solar activity in the first half of the month was divided between H, J, and A groups and a D group which passed through the central meridian on 4 July. In the latter only flares of importance 1 were reported. The most active center of the month (27°N, L = 118°) passed through the meridian on 28 July; this was magnetically complex and emitted radio and x radiation, but no protons, and flares of importance 2 were noted between 24 and 31 July. In August the relative number of sunspots was up 13% to 99.1. The F group passing through the meridian on 28 July emitted flares of importance 2 until 4 August, when it rotated beyond the west edge with protuberances. Then the activity decreased until the middle of the month. The latter part of the month saw the F group and E group pass through the central meridian, producing flares of importance 2 particularly on 29 August, with strong radio emission and ionospheric phenomena. No magnetic storms were reported in either month. (BBB)

34198 UPPER LIMITS TO THE DEGREE OF CIRCULAR POLARIZATION OF THE INTEGRATED 1418-MHz RADIATION FROM RADIO GALAXIES. Seielstad, G. A.; Weiler, K. W. (California Inst. of Tech., Pasadena). Astron. J., 73: 1-6(Feb. 1968).

Upper limits to the net degree of circular polarization in the integrated radiation of 57 discrete radio sources, all believed to be extragalactic, were measured at a frequency of 1418 MHz. In no case does the signal significantly exceed its error. Consequently no certain detection of circularly polarized radiation is claimed from any of the sources studied. The results greatly extend the number of objects for which circular polarization data are available. The upper limits to the degree of circular polarization are in many instances lower by an order of magnitude than previously published values. The interference polarimeter for detecting circularly polarized radiation has the advantage of the null technique possible with orthogonal linearly polarized feeds. The physical separation between the two feeds, so that cross coupling between them is negligible, is important. Upper limits to the average magnetic field strengths, modified by a geometrical factor, were calculated. Values were in the range 0.14 to 3.9 × 10^{-3}G. If degrees of circular polarization smaller by a factor of 3 to 5 can be measured, field strengths comparable to typical equilibrium values may be detected. (BBB)

34199 UTILITY SYSTEM EFFECTS OF SPACE PLASMAS. **Scott, Russell L. IEEE (Inst. Elec. Electron. Eng.) Spectrum., 5: 93-5(Mar. 1968).**

During the next International Geophysical Year, the nature of solar flares, the travel through space of their plasma or ionized gases, and their arrival and influence on earth will receive considerable attention. Some utility systems will experience real and reactive voltage variations; transformers, underground cables, pipelines, grounded devices, and systems will experience large current flows; and Earth environmental fields will undergo large amplitude and erratic frequency changes as effects of solar activity. The effects of a solar flare that occurred near the Earth side of the Sun on November 12, 1960, at about 1323 UT are considered in detail. The effect on vlf communications at several points across the U. S. A. is documented. The effects of environmental conditions—wind, ionized air, magnetotelluric-field activity—and system voltage, position, and the conductors' mechanical characteristics are interrelated as are the effects on them of solar plasma. Vibration increases with ionization level gain from space plasma as noted near Fargo, N. Dak., during the November 12, 1960, storm. Long duration and high amplitude of vibration clearly mark the arrival of the storm on the charts. From other data on utility system lines, conductor vibration has a frequency—range power spectrum very similar to values recorded for the Earth's natural electric field by comparison of charted data. (BBB)

34200 EXTRAGALACTIC RADIO SOURCES. **Elsaesser, Hans; Scheffler, Helmut (Landessternwarte Heidelberg-Koenigstuhl, Ger.). Naturwiss. Rundsch., 27: 102-7(Mar. 1968). (In German).**

An introductory discussion of extragalactic stellar systems is given. Determinate information on quasistellar radio sources is given, particularly the red shift of these objects. Spectra of radiogalaxies and quasars, including polarization, are outlined in terms of synchrotron radiation. The significance of these objects in terms of cosmological history is discussed; they are considered the initial phases of exploding galaxies. A study of the radiogalaxy M82 is noted; the explosion should have begun about 10^6 years ago. Radiohalos of many galaxies in which synchrotron radiation is found, may be a later stage of such explosions. Such an effect may be noted in our Galaxy. The problem of energy production in radiogalaxies is developed. Conceivably radio sources are galaxies too distant for telescopic (optical) detection. Understanding of these sources will contribute to evaluation of models for the Universe. (BBB)

34201 SUPERNOVAE AND SUPERNOVA REMNANTS. **Poveda, A. (Universidad Nacional de Mexico); Woltjer, L. Astron. J., 73: 65-74(Mar. 1968).**

Criteria of identification of supernova remnants are discussed and a catalogue of 25 supernova remnants is presented. The objects are shown to satisfy a relation between radio surface brightness at 400 Mc and radius with quite small scatter. On the basis of this relation, distances can be determined. The accuracy of these distances is sufficient to show that the supernova remnants delineate local spiral structure as clearly as do young galactic clusters. Evidence is presented that remnants in the galactic halo expand faster than those in the disk. Because of this the sample contains mainly type-II supernova remnants. Ten positional coincidences to within 2.5° between supernova remnants and x-ray sources are noted in a sample where less than 2 random coincidences are expected. The x-ray emission appears to be correlated with age, declining more slowly than the radio emission in the early phases. The relation between surface brightness and radius does not satisfy Shklovsky's theory. A possible explanation of the observed relation is given. The optical spectra of the remnants are discussed and the inadequacy of the usual treatment of collisional excitation is noted. The energies of some remnants are evaluated and are below 5×10^{49} erg. There is no evidence that supernovae of type II are catastrophic events related to ultimate stellar collapse. (BBB)

34202 GALACTIC RADIO EMISSION AT 610.5 MHz. I. THE REGION BETWEEN GALACTIC LONGITUDES 47° AND 56°. **Wendker, H.; Yang, K. S. Astron. J., 73: 61-4(Mar. 1968).**

By observations made with the 122-m radio telescope at the Vermilion River Observatory, a section of the galactic plane between galactic longitudes 47° and 56° was surveyed at 610.5 MHz with a resolution of 16 min of arc. A contour map is presented for this region. At least 13 discrete sources can be recognized, the radio properties of which are discussed. The values of the brightness temperature above the baseline were determined for points separated by 30ˢ intervals in right ascension along the averaged cross section. All these brightness temperature values were then arranged into an intensity matrix from which the contour map was drawn. Of the 13 local maxima, 12 lie very close to the galactic plane. These sources are listed in a table which gives a designation using galactic coordinates and the positions of 1950.0 celestial coordinates. The peak brightness temperature above the zero level was measured for each source. This peak temperature contains a strong component from the unresolved galactic background radiation. Attempts to compare the results with those at other frequencies were not very successful because of the lack of additional high-resolution data for this region except for the area around the sources G49.1−0.4 and G49.4−0.4. The other available information is summarized. The peak brightness temperature, background level, and brightness temperature for each source are given. (BBB)

34203 COSMOLOGY AND OBSERVATIONS. I. Godart, O. (Univ., Louvain, Belguim). Ann. Soc. Sci. Brux. Ser. I, 82: 43-71(Apr. 25, 1968). (In French).

The basic conclusions of relativistic cosmology are summarized. The basic fundamental cosmological relations are given. Some general characteristics of cosmological models are examined. The relations describing distance and velocity in cosmology are derived. The material density is considered. The characteristics of radiogalaxies and quasars are given. The radiated energy density of cosmic sources is evaluated. (J.S.R.)

34204 DIFFUSION OF HEAVY IONS IN THE SOLAR CORONA. **Alloucherie, Yves Jean. College Park, Md., Univ. of Maryland, 1967. 115p.**

Thesis.

The steady-state diffusive motion of ionized atoms in the solar corona was investigated theoretically, with special emphasis on relating the flow velocity and density of these ions to the flow properties of the ionized hydrogen background, under the assumption that the Sun and its environment exhibits total spherical symmetry. The basic approach taken in this study was to regard the ions as "test particles" immersed in, and interacting with, the electrons and protons making up the bulk of the corona. Two forms of the momentum equation were first derived for the ions, taking into account the effect of the following forces: the solar gravitational force, the kinetic friction force with the background electrons and protons, the electric force due to the gravity induced charge polarization of the electrons and protons, and the pressure gradient force. The first form of the equation is applicable to "cool" ions which have not yet reached thermal equilibrium with the "hot" background, while the second form assumes temperature equality between the ions and the protons. The momentum equation contains, as variable parameters, the density, velocity, and temperature of the electrons and protons. Since the ions have been assumed to be "test particles," they do not appreciably disturb the state of the ionized hydrogen background, and the above parameters may be obtained from existing dynamical models of the solar corona, which were obtained by neglecting the presence of the ions. Two such models have been specifically considered in this thesis: the one-fluid model of Parker (which postulates identical temperatures for the electrons and protons), and the two-fluid model of Sturrock and Hartle (which postulates different temperatures for the electrons and protons). The momentum equation was then combined with the equation of conservation of mass for the ions to give a first-order, nonlinear differential equation for the flow velocity of the ions. As a first step in the solution, an approximate, asymptotic relation was then derived, giving the physical conditions under which ionized atoms may either diffuse upward in the corona, remain at rest in equilibrium, or fall down toward the solar interior. A representative sample of ions satisfying the condition of upward convection was selected, and the velocity equation was solved numerically on a CDC 160-A computer for each one of these ions, using the model of Parker and the model of Sturrock and Hartle. These results were combined with the equation of conservation of mass to give, as a function of distance from the center of the Sun, the relative abundance of these ions in the corona. It was found that the ions considered in the sample diffuse away from the Sun with velocities somewhat lower than the velocity of the hydrogen background; the relative abundance of the ions, after a slight decrease near the bottom of the corona, increases gradually and slowly with height. (Diss. Abstr.)

34205 RADIATIVE TRANSFER IN FINITE EXTENDED STELLAR ATMOSPHERES. **Pearce, William Patrick. Evanston, Ill., Northwestern Univ., 1967. 128p.**

Thesis.

This investigation was devoted to finding an approximate solution to the radiative transfer equation in a finite, grey, spherically symmetric, isotopic, purely scattering atmosphere in radiative equilibrium. The curvature of the atmospheric layers was explicitly taken into account, with the objective of obtaining results which may be applied to the case of an atmosphere which is extended in the sense that the intensity scale height at a point in the atmosphere is not negligible relative to the local radius of curvature. (TSS) (Diss. Abstr.)

34206 A STUDY OF MULTIPLE STAR SYSTEMS INVOLVING COMPONENTS OF SPECIAL ASTROPHYSICAL INTEREST. **Meisel, David Dering. Columbus, Ohio, Ohio State Univ., 1967. 97p.**

Thesis.

Sixty-six visual double star systems were studied both spectroscopically and photometrically. The systems selected for study involve components of special astrophysical interest mainly among the OB, Be, and supergiant stars. Also some pairs including variable stars, peculiar-A stars, and high-velocity stars were considered. Using spectrograms with dispersion 40 Å/mm, Morgan–Keenan (MK) spectral types, and V sin i values were obtained for at least two stars in each system. Photographic hydrogen line (Hγ) equivalent widths were measured for a number of the early-type components. In addition, photoelectric magnitude differences (Δm) and Balmer-line indices (Hβ and Hγ) were measured for a number of systems not previously investigated. Sixteen of the systems studied were judged to be optical after intercomparison of Δm's, MK types, single plate radial velocities and proper motions (where available). In the remaining sample of stars, the absolute magnitude calibration of the stars of interest could be carried out using the MK types for the "normal" companions and Δm's for the systems. Absolute magnitudes also were derived from Balmer line equivalent widths and photoelectric indicies for a number of early-type components. The results for Be stars, OB stars, and supergiants are discussed. No significant differences between mean V sin i values for single stars and those obtained for double stars were found. Statistics relating to the effects of axial rotation on the absolute magnitudes of nonemission components on or near the main-sequence are presented. Various hypotheses about the interpretation of Be stars are briefly reviewed. (Diss. Abstr.)

34207 AN ABSOLUTE CALIBRATION OF THE ENERGY DISTRIBUTION OF TWELVE SPECTROPHOTOMETRIC STANDARD STARS. **Hayes, Donald Scott. Los Angeles, Univ. of California, 1967. 98p.**

Thesis.

Spectrum scans of the stars α Lyrae, κ Aquilae, 58 Aquilae, ϵ Aquarii, 29 Piscium, ξ^2 Ceti, ϵ Orionis, γ Geminorum, η Hydrae, α Leonis, θ Crateris, and θ Virginis were compared with scans of two Phillips tungsten ribbon-filament standard lamps, and energy distributions derived. These lamps were calibrated for energy distribution in Heidelberg in 1958 and 1966. (TSS) (Diss. Abstr.)

34208 CARBON-BURNING STARS. **Beaudet, Gilles. Ithaca, N. Y., Cornell Univ., 1967. 157p.**

Thesis.

Models for stars of an initial composition of 50% (per mass) carbon and 50% oxygen were calculated using the Henyey method. General formulas were derived for the equations of state, the dielectric constants, and the energy losses due to neutrino processes in a hot plasma; the creation of positron-electron pairs is considered an important development. Two sets of models were run, one without neutrino energy losses, which include the .75 $M_\odot$, .80 $M_\odot$ and 1.25 $M_\odot$ models, and one with neutrino energy losses, which includes the .75 $M_\odot$, .95 $M_\odot$, 1.00 $M_\odot$, 1.05 $M_\odot$ and 1.25 $M_\odot$ models. The minimum mass for carbon burning is found to be .79 $M_\odot$ in the absence of neutrinos, and approximately 1.00 $M_\odot$ if the neutrino losses are included. All models with neutrinos which burn carbon show a large carbon flash, but the same models without neutrinos do not. The 1.00 $M_\odot$ model is peculiar in the sense that carbon burning is first triggered in a shell and not at the center. The maximum central temperature of the 1.25 $M_\odot$ model without neutrinos is insufficient to trigger oxygen burning. (Diss. Abstr.)

34209 TRANSIENT FLARE-ASSOCIATED PHENOMENA IN THE SOLAR ATMOSPHERE. **Anderson, Gerald Francis. Boulder, Colo., Univ. of Colorado, 1967. 243p.**

Thesis.

Recent high time resolution studies of Hα filtergrams of the solar disk have revealed the presence of short-lived phenomena which occur in association with solar flares. A well-defined contrast fluctuation is seen to propagate away from the flare region and, upon encountering a filament, to cause the absorption profile of the filament to undergo several periodic oscillations. Using the flare patrol data of the Lockheed Solar Observatory, the characteristics of a particular propagating disturbance (that of 20 September 1963) and its subsequent effects upon filaments are discussed in detail. A theoretical model is developed for the disturbance. The distance is assumed to consist of a magnetohydrodynamic pulse which is generated by a source located in the flare region, propagates away from the source, and is refracted in the solar corona. A portion of the disturbance front arrives at chromospheric levels, where the sequential times of arrival of different elements of the front are manifested as a progressive contrast fluctuation. The internal structure of the disturbance is reflected in the response of chromospheric material, which is assumed to be a passive sensor of the perturbative velocity field within the disturbance. Ray tracing calculations were undertaken to compute the progress of the disturbance front in a model atmosphere threaded by a dipolar magnetic field. The results, when fitted to the observations, yield source heights and magnetic field strengths and polarities at photospheric levels which are consistent with other observations of these quantities. (Diss. Abstr.)

34210 MODEL PLANETARY NEBULAE: ELECTRON TEMPERATURES AND IONIZATION STRATIFICATION. **Harrington, James Patrick. Columbus, Ohio, Ohio State Univ., 1967. 86p.**

Thesis.

A sequence of model planetary nebulae was constructed in order to determine the electron temperature and ionization structure; various auxiliary quantities, such as the total emission in certain lines of H I, He I, He II, [O II], and [O III], were also calculated. The nebulae are idealized as homogeneous spherical shells illuminated by central stars whose flux is represented by the model atmospheres of Böhm and Deinzer. The radius and density are chosen so that the models fall on the Seaton sequence. The gas is considered to be composed of H, He, C, N, O, and Ne. The cooling of the gas by collisional excitation includes the fine structure levels as well as the transitions between the terms, and full account is taken of collisional de-excitation. The thermal stability of the gas against the formation of condensation is tested at each point. The radiative transfer problem is solved by iteration. The intensity of the diffuse radiation in the n$^{\text{th}}$ approximation is obtained directly by integrating the source function of the previous approximation numerically over the shell. For the initial approximation, the radiation is assumed to be absorbed on the spot for the optically thick models, or is neglected altogether for those which are optically thin. The iterations are continued to convergence. The source function of the radiation produced by the gas includes the contributions of the Lyman continua of H^0, He^0, and He^+, the Balmer continuum of He^+, and the two-photon emission of He^+ and He^0. The Lyman alpha radiation of He^+ is included and is assumed to be absorbed on the spot by H^0 and He^0. All models constructed were found to be thermally stable throughout. (Diss. Abstr.)

34211 A SPECTROSCOPIC AND PHOTOMETRIC INVESTIGATION OF THE STELLAR ASSOCIATION CEPHEUS OB2. **Simonson III, Simon Christian. Columbus, Ohio, Ohio State Univ., 1967. 158p.**

Thesis.

Cepheus OB2 was investigated with spectral classification and photometry. Sixty-two stars of types O and B were classified on the MK system using spectrograms at 80 Å/mm taken with the 72-inch telescope. Photoelectric UBV observations of these stars and 20 fainter stars were made with the 21-inch telescope at the Lowell Observatory. Objective prism spectra at 1000 Å/mm were taken over an area of 100 square degrees covering the association, and stars of type O and B were classified to a limiting magnitude B = 11.5. The V magnitudes and B−V colors of these stars were measured on plates taken with a 4-inch Ross camera. The results show that the stars assigned to the association by Morgan, Whitford, and Code and Markarian are distributed across the spiral arm from 300 pc to 1400 pc. However, between 750 pc and 1050 pc a group of stars is found that has most of the characteristics of OB associations in the solar neighborhood. The clusters Trumpler 37, immersed in the H II region IC 1396, and NGC 7160 are found here at a distance of 850 pc, along with several luminous, evolved stars. The integrated absolute magnitude of the group is about −9, and the mass is in excess of 10^3 solar masses. Radio observations show an excess of neutral hydrogen above the galactic plane in this direction and indicate the presence of a shell of neutral hydrogen surrounding IC 1396. Several possible new clusters in the region are identified, including one surrounding 19 Cephei (09.51b). The radial velocities and proper motions are rediscussed using the photometric distances, and the hypothesis of linear expansion of the group from a small prestellar body is found to be unsupportable. (Diss. Abstr.)

34212 THERMAL GENERATION OF HYDROMAGNETIC WAVES IN SUNSPOTS. **Savage, Blair DeWillis. Princeton, N. J., Princeton Univ., 1967. 78p.**

Thesis.

Calculations on the hydromagnetic stability of a thermally unstable layer traversed by a vertical magnetic field with open boundary conditions were extended to include the effect of hydromagnetic wave reflection due to a rapidly decreasing density with height above the layer. The wave reflection was studied by determining the effect of standing surface gravity waves arising from a density discontinuity at the boundary of a superadiabatic layer and an adiabatic region above. For parameters characteristic of solar magnetic regions, the presence of gravity waves tends to close the boundaries and therefore reduces the threshold for emission of hydromagnetic waves by overstable oscillations in the layer. The calculations predict that overstable oscillations and hence thermal hydromagnetic wave generation will occur in sunspots with vertical magnetic field strengths less than approximately 4000 gauss. For larger field strengths no unstable modes are found. (Diss. Abstr.)

34213 A KINEMATIC STUDY OF FAINT A STARS. Young, Arthur. Bloomington, Ind., Indiana Univ., 1967. 167p. Thesis.

Radial velocities were determined for 333 stars of spectral class B8 to A2, and apparent visual magnitudes between +10 and +11.5. Photoelectric UBV photometry of 50 of these stars indicate that they are strongly reddened, with a mean distance of 600 parsecs. The effect of galactic rotation on the radial velocities of these stars is too small to be detected with certainty owing to the large cosmic dispersion in both velocity and distance, and to the large measurement error. The cosmic dispersion in velocity is larger than normal for A stars (Σ_u = 21 km/sec, Σ_v = 18 km/sec), and indicates a nearly spheroidal distribution. A streaming effect similar in magnitude and direction to the Ursa Major (Sirius) Group is observed among the faint A stars, but not among the bright ones. The existence of a local "group" not partaking in the general "streaming" is suggested. (Diss. Abstr.)

34214 CEPHEID PULSATIONS. Cox, Arthur N. (Los Alamos Scientific Lab., N. Mex.); Cox, John P. Contract W-7405-eng-36. Sky Telesc., 33: 3-7(May 1967). (LA-DC-8195).

The physical causes of stellar pulsation in the Cepheid, RR Lyrae, and possibly also the W Virginis variables, now seem to be understood in some detail. Numerical integration techniques are discussed which give insight into the pulsation mechanism for Cepheids. (W.D.M.)

34215 ESTIMATION OF INDUCED RADIOACTIVITY IN STONE METEORITES. Lavrukhina, A. K.; Ustinova, G. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 179: 1448-51(Apr. 21, 1968). (In Russian).

The strong variations in the isotopic concentrations in stone meteorites are of great interest for determinations of the age of matter in the solar system. Following up similar studies on iron meteorites, the intensity distributions of nuclear-active materials in chondrites with radii of 10, 20, 30, 50, 80, 100, and 200 cm were calculated on the basis of the generation of secondary particles. It was found that the most favorable conditions for the development of secondary-particle cascades are present in chondrites of 20- and 30-cm radius. Comparison of the rate of formation of ^{22}Na, ^{49}V, ^{36}Cl, and ^{39}Ar (in minutes) and the buildup of ^{39}Ar in 4 million years in chondrites and iron meteorites revealed that the activity of these isotopes is higher in the iron phase of chondrites; the depth effect is weaker in chondrites in which the contribution of nuclear reaction with secondary particles is also stronger. (TTT)

34216 EVENT HORIZONS IN STATIC ELECTROVAC SPACE-TIMES. Israel, Werner (Inst. of Advanced Studies, Dublin). Commun. Math. Phys., 8: 245-60(1968).

The following theorem is established. Among all static, asymptotically flat electrovac fields with closed, simply connected equipotential surfaces g_{00} = const., the only ones which have regular event horizons $g_{00} = 0$ are the Reissner–Nordström family of spherisymmetric solutions with $m \geqq G^{1/2}|e|/c$. In the special case where the gravitational coupling of the electromagnetic energy density is neglected ($G = 0$) all solutions are computed explicitly, thus extending an earlier result of Ginzburg for a magnetic dipole in Schwarzschild's space–time. Possible implications for gravitational collapse are briefly discussed. (auth)

34217 INFLUENCE OF A STELLAR DENSITY GRADIENT ON THE GRAVITATIONAL MICROFIELD IN STELLAR CLUSTERS. Birn, J.; Weise, K. (Technische Hochschule, Hanover). Z. Phys., 212: 449-57(1968). (In German).

The probability distribution of the gravitational microfield at a fixed space point in a stellar cluster is determined using the Markov method and neglecting statistical correlations between individual stars so that they are moving independently of each other in the macroscopical field of the whole cluster. In presence of a stellar density gradient, the distribution of the deviations from the mean gravitational field is found to be anisotropically deformed Holtsmarkian with its maximum shifted to a field deviation vector antiparallel to the density gradient. (auth)

34218 EARLY UNIVERSE. Harrison, Edward R. (Univ. of Massachusetts, Amherst). Phys. Today, 21: 31-9(June 1968).

The evolution of the Universe through its various eras is reviewed in terms of the hadron era, lepton era, radiation era, and stellar era. The Gamow model, origin of galaxies, and antimatter are discussed. (W.D.M.)

34219 STRONG SURGE OF SOLAR ACTIVITY ON SEPTEMBER 2, 1966, ACCORDING TO OBSERVATIONS AT ALMA-ATA. Konstantinov, V. A. (Ionosphere Section, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 710-11(1967).
Translated from Geomagn. Aeron., 7: 876-7(1967).

A large flare on the Sun was recorded from 5h 48m to 7h 23m UT on Sept. 2, 1966. The observations were made with a radiometer of a sensitivity of 10^{-13} W and a parabolic antenna with an aperture area of 21 m^2 and azimuthal mounting. A continuous trace of the solar radio noise flux is shown. (W.D.M.)

34220 ENERGY FLUX IN THE SOLAR WIND. Ivanov, K. G.; Kovalevskii, I. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 714-15(1967).
Translated from Geomagn. Aeron., 7: 880-1(1967).

The parameters of the interplanetary medium have been measured on many spacecraft. The most complete data on simultaneous plasma and magnetic field observations were published for Mariner 2. These data were used previously to estimate the density of various types of energies. The conclusion was reached that the energy density of directional plasma motion exceeds by far the density of thermal and magnetic energy. The Mariner 2 data also make it possible to compute the flux densities of various types of energy in the vicinity of the Earth's orbit (0.8 to 1 AU), as is done in the present note. (W.D.M.)

34221 SMALL-SCALE INHOMOGENEITIES OF THE MAGNETIC FIELD OF THE SOLAR CORONA AND OF INTERPLANETARY PLASMA. Vitkevich, V. V.; Lotova, N. A. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 636-8(1967).
Translated from Geomagn. Aeron., 7: 780-3(1967).

The lower limits of magnetic field values were estimated by radio-astronomical methods on the assumption of the presence in inhomogeneities of a frozen-in magnetic field. Attention is drawn to the necessity of performing rocket measurements of magnetic inhomogeneities for a frequency spectrum, ν, from 10^{-3} to 6×10^{-2} Hz. (auth)

34222 DISTRIBUTION OF ENERGY DENSITY AND PRESSURE IN THE SECTOR STRUCTURE OF THE QUIET INTERPLANETARY MAGNETIC FIELD. Kovalevskii, I. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 639-42(1967).
Translated from Geomagn. Aeron., 7: 784-8(1967).

The IMP-1 data were used to compute the energy density and pressure of the solar plasma and of the magnetic field for the sector structure of the quiet interplanetary magnetic field observed at a distance from the Earth's orbit from December 1963 to February 1964. The ratios of the energy density of directional and thermal motions to the energy density of the magnetic field were computed, as well as the ratios of the dynamic and static pressures of the plasma to magnetic pressure. The distribution of these parameters in the sectors and their relation to geomagnetic activity and to the intensity of galactic cosmic rays are discussed. (auth)

34223 HOMOGENEOUS MODELS OF NON-STATIONARY "UNIVERSES." Stanyukovich, K. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 1, 17-24(Jan.-Feb. 1968). (In Russian).

The homogeneous models of universes, generalized from the known solution of de Sitter, were examined. (tr-auth)

34224 COSMOLOGY AFTER HALF A CENTURY. McCrea, W. H. (Univ. of Sussex, Eng.). Science, 160: 1295-9(June 21, 1968).

A brief history of the modern study of cosmology, beginning with the publication of Einstein's paper of 1917, is given. Big-bang cosmology is considered in terms of the observational support for the theory and conceptual difficulties inherent in the model. (W.D.M.)

34225 DURATION OF THE ZONAL SPOT ACTIVITY. Gleissberg, W. (Univ., Frankfurt am Main). Solar Phys., 4: 93-5(May 1968).

The duration of zonal spot activity (D) on each hemisphere was determined within zones of 5° in latitude between 0 and 40°

from a recent drawing of the butterfly diagram and from the Zürich Heliographic Maps; from these values of D, the mean duration was computed for corresponding Northern and Southern latitude zones. The following conclusions are drawn: (a) D increases, on the average, from about 3 years at latitude zone 35 to 40° to more than 9 years at 10 to 15° and remains nearly constant at lower latitudes; (b) in 11-yr cycles showing a strong preponderance of one hemisphere over the other with regard to total area of sunspots, the mean D is longer on the more spotted hemisphere; and (c) no correlation seems to exist in the 11-yr cycles between the height of the maximum of sunspot frequency and the mean duration of the zonal-spot activity. (L.M.T.)

34226 THE EFFECT OF MAGNETO-SONIC WAVES ON A ZEEMAN TRIPLET WITH APPLICATION TO SUNSPOTS. **Maltby, P. (Univ. of Oslo). Solar Phys., 4: 96-8(May 1968).**

Maltby and Eriksen (Solar Phys., 2: 249(1967)) suggested that the Evershed effect in sunspots may be interpreted as an acoustical wave phenomenon. They showed that asymmetric line profiles similar to those observed in sunspot penumbrae may be produced by either progressive sound waves propagating along the magnetic lines of force or by longitudinal compression waves propagating perpendicular to the magnetic field. A brief theoretical analysis of the latter-type waves is presented here. If waves of this type are present in sunspot penumbrae, one would expect magnetic active lines to show larger wavelength shifts than inactive lines; results from a study by Servajean (Ann Astrophys., 24: 1(1961)) showed 11 of 14 lines with a much larger wavelength shift than expected. The Servajean observations seem to support the interpretation of the Evershed effect as a wave phenomenon, but a more detailed analysis is necessary. (L.M.T.)

34227 A TYPICAL TWISTED SURGE ON NOVEMBER 10, 1967. **Dizer, M. (Kandilli Observatory, Istanbul, Turkey). Solar Phys., 4: 99-100(May 1968).**

A large sunspot group at 21 S crossed the solar disk between October 29 and November 10, 1967. During its passage across the disk, the spot area was not very active with respect to flares. But on November 10, a flare occurred in this active region during Western-limb passage; it was situated at 21 S, 239, evolved rapidly and gave origin to a bright surge on the disk extending beyond the limb. It was observed with the Hα solar patrol instrument at the Kandilli Observatory. This flare started approximately as a bright knot over the umbra of the largest spot of the active region. At 08:30 UT an ejection occurred in the area where the flare appeared. Within the next few minutes, a bright ball appeared at the top of this ejection and became larger. After that, this event became strongly activated and straightened out perpendicular to the solar surface. The projected velocity of the bright ball reached about 480 km/sec. At 09:30 UT, higher up, the prominence broke up into small knots and some of these were blown off, by the action of the active area. Within the next few minutes, it was very diffuse and had disappeared completely by 10:02 UT. A series of Hα photographs depicts the progress of the event, which reached a height of 223,900 km. Bumba (Izv. Krymsk. Astrofiz. Observ., 13: 42(1962)) proposed a model of the magnetic structure in sunspot umbra, in which the field lines are inside a tube of force proceeding from the umbra, twisting into spirals having a pitch angle steeply increasing with height. In the observed event the flare material moved along a spiral-like path at lower heights, but at high altitudes, the curvature of their arms was practically normal to the solar surface. This observation seems to agree with Bumba's model, which predicts a similar pattern for the magnetic structure above a sunspot. (Entire text)

34228 REMARKS ON MY PAPER ABOUT FORCE-FREE MAGNETIC FIELDS AND SOLAR FLARES. **Anzer, Ulrich (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Solar Phys., 4: 101-3(May 1968).**

In a preceding paper (Solar Phys., 3: 298(1968)), an abstract of which appeared in NSA 22: 29167, the author referred to the works of others concerning the stability of force-free fields with α = const. in a note added in proof. Points which could not be sufficiently clarified in this short footnote are discussed here in detail. It is pointed out that, although the force-free field discussed by Callebaut and Voslamber (Phys. Rev., 127: 1857(1962)) is not applicable to stationary astrophysical problems, it may be applicable to terrestrial plasma physics. (L.M.T.)

34229 RELATIVE ABUNDANCE OF SILICON AND IRON IN THE SOLAR CORONA. **Jordan, Carole (United Kingdom Atomic Energy Authority, Abingdon, Eng.); Pottasch, S. R. Solar Phys., 4: 104-7(May 1968).**

Dupree and Goldberg (Solar Phys., 1: 229(1967)) derived, from the EUV spectrum, a coronal abundance of iron relative to silicon, which is in agreement with the photospheric value. The authors of this note, in separate earlier papers, showed the relative abundance to be an order of magnitude greater in the corona than in the photosphere. Reasons for this difference are examined here, and it is concluded that Dupree and Goldberg were led to an incorrect solution because of neglect of the majority of the observed iron lines which lie between 168 and 274 Å. (L.M.T.)

34230 MEASUREMENTS OF SOLAR X-RAY EMISSION FROM THE IONS CARBON VI AND NITROGEN VII. **Evans, Winifred Doyle. Albuquerque, N. Mex., Univ. of New Mexico, 1967. 178p.**

Thesis.

Two identical instrument packages containing x-ray crystal spectrometers were flown aboard Nike–Tomahawk sounding rockets launched from Kauai, Hawaii, on August 8 and 11, 1967. Each package contained eight curved-crystal, nonscanning spectrometers focused for selected wavelengths of the solar spectrum between 19 and 34 Å. During the high-altitude portion of the flight, the instrument axis was aligned toward the sun by an attitude control system. Four of the spectrometers used lead stearate soap film analyzers. Three were focused for the Lyman-α, -β, and -γ lines of C VI. The fourth was focused to obtain a measurement of the continuum intensity at 26.0 Å. Three spectrometers using KAP crystals were focused for the first three lines of the N VII Lyman series. The eighth spectrometer had the crystal replaced by a polished aluminum surface to test the sensitivity of the instruments to scattered ultraviolet light. Data were obtained from all stations on the first flight. On the second flight two of the KAP spectrometers failed, probably because of broken crystals. The count rates in all stations were essentially constant during the entire five minute period that the packages were above the atmosphere. On both flights excellent data on atmospheric absorption were obtained during the reentry portion of the flight. From the data of the first flight, intensities of 1.8 and 0.5×10^{-3} erg/cm^2-sec were determined for the N VII Lyman-α and -β lines respectively. The x-ray flux at 19.83 Å was interpreted as continuum radiation with an intensity of 5×10^{-3} erg/cm^2-sec-Å. The expected line structure for the C VI Lyman series was not observed. Because of an inconsistency in the absorption data it was suspected that the stearate stations were sensitive to x-ray wavelengths outside the expected instrumental resolution. Laboratory measurements were made of the specular reflection of long wavelength x rays from lead stearate crystals. For those spectrometers focused on the weaker lines and the continuum, specularly reflected x rays from the 40- to 120-Å region almost certainly introduced large errors. The measurement of the strong C VI Lyman-α line was less seriously affected. When a correction was made for the specular reflection the intensity of this line was found to be 2.9×10^{-2} erg/cm^2-sec on August 8 and 2.2×10^{-2} erg/cm^2-sec on August 11. The continuum intensity at 26.0 Å was 6×10^{-3} and 4×10^{-3} erg/cm^2-sec-Å on the two days. (Disser. Abstr.)

34231 THE STRUCTURE OF A SUNSPOT. III. OBSERVATIONS OF THE WILSON EFFECT. **Wilson, P. R.; Cannon, C. J. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Solar Phys., 4: 3-17(May 1968).**

White-light photographs of a fairly regular sunspot were obtained for all but one day of its passage across the disk. From microphotometer tracings across these photographs, intensity profiles across the spot were obtained at several heliocentric angles, θ. Apparent sunspot, umbral, and penumbral widths were obtained from these profiles, and an examination of these reveals that the well-known Wilson effect (Wilson, 1774) is a rather complex phenomenon comprising four main features: (1) The intensity profiles become increasingly asymmetric at large θ The penumbra remote from the limb is poorly defined while the penumbral intensity plateau nearer the limb is well defined and sometimes enhanced by an intensity maximum near the umbra–penumbra boundary. (2) A gradual decrease in the apparent width of the disk-side penumbra may occur but this effect is barely significant compared with the rms errors of the observations. (3) The apparent width of the limb-side penumbra is independent of θ for $0 < 60°$ but at larger heliocentric angles it increases sharply and by a significant amount. (4) The apparent umbral diameter also shows no θ dependence for $\theta < 60°$, but beyond this it decreases in an almost complementary manner. A general model for the structure of a sunspot is put forward which readily explains these results in a qualitative manner but it is emphasized that an adequate analysis of sunspot structure based on these observations requires solutions of the three-dimensional equation of radiative transfer. (auth)

34232 LONG-TERM FORECASTS OF PROTON FLARES. **Svestka, Zdenek (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondrejov). Solar Phys., 4: 18-29(May 1968).**

174 proton flares observed during the period from 1956 to 1965 occurred in 81 different active regions. These active regions formed in complexes of activity, which stayed on the solar surface for many months, and in some cases even for several years. Since the proton-flare regions develop very rapidly and reach the proton-flare active stage within a few days, these complexes of activity represent the areas on the sun, where proton-flare regions can form at any time. Reference is made to contributions by Bumba and Howard, who investigated the birth of active regions and detected some properties of complexes of activity; nevertheless, at the present time, no method is known to predict when a proton-flare region begins to develop in such a complex of activity. On the other hand, there is a chance of predicting the dangerous longitudes on the sun, as soon as such a complex of activity has been well recognized or, from the opposite point of view, to predict the safe proton-flare free periods on the sun. If, however, all the complexes on both the hemispheres are taken into account and every complex is considered "proton-dangerous" from 2 days before to 7 days after the central meridian passage, one can prove that no proton-flare free periods existed for more than 3 years around the maximum of the last solar cycle. Applying this result to the present cycle, one can conclude that no safe forecasts of proton-flare free periods can be made from the beginning of 1968 to the end of 1970. During the remaining 7 or 8 years of the solar cycle, long-term forecasts of proton flares could be made provided that our knowledge of the formation and development of the complexes of activity is improved. It is of interest to notice some properties of the complexes formed in the last solar cycle. While the complexes on the Northern solar hemisphere remained at fairly constant heliographic longitudes for many years, the complexes formed on the Southern hemisphere seemed to travel in two rows around the sun, in the direction opposite to the solar rotation. Another interesting fact is a yearly periodicity in the formation of proton-flare regions in the complexes of activity, with a maximum in the summer period and a deep minimum in the winter season. Such a seasonal variation also appears, if one considers the flare activity, type-IV bursts, PCA's, great magnetic storms, and magnetic crochets. Therefore, one can reasonably believe that this yearly variation, even when similar to the seasonal variation at the Earth, is of solar origin. (auth)

34233 PROPAGATION OF HYDROMAGNETIC DISTURBANCES IN THE SOLAR CORONA AND MORETON'S WAVE PHENOMENON. Uchida, Yutaka (Tokyo Univ.). Solar Phys., 4: 30-44(May 1968).

Moreton's wave phenomenon, observed to propagate across the solar disk during certain solar flares, may be explained as the intersection line between an expanding coronal wavefront surface and the chromosphere: The propagation of a hydromagnetic disturbance in a spherically symmetric model corona with a radial magnetic field is studied in the WKB approximation, and the propagation paths of wavepackets, the shape of the wavefronts expanding in time, and the variation of the direction of material oscillation along the paths are discussed for disturbances in hydromagnetic wave modes. It is shown that the wavefront expanding in fast-mode in the corona has a circular intersection line with the chromosphere, which sweeps on the solar surface with a velocity and a direction of material oscillation just favorable for explaining the observed features of the phenomenon. (auth)

34234 TIME VARIATION OF THE SPECTRUM OF GYRO-SYNCHROTRON EMISSION FROM THE SUN. Takakura, Tatsuo; Uchida, Yutaka; Kai, Keizo (Tokyo Univ.). Solar Phys., 4: 45-57(May 1968).

The emission spectra and their time variations of gyro-synchrotron emission from an ensemble of energetic electrons are computed for some initial power-law distributions of the electron energies $N(\epsilon)d\epsilon = \epsilon^{\nu}d\epsilon$ with $\gamma = 2$ or 4. The spectra and decay curves of the emission are compared with solar microwave bursts in order to separately estimate the magnetic field H and γ. From a limited number of observations, values of $\gamma \approx 3$ and $H \approx 10^3$ gauss for the microwave impulsive bursts, and $\gamma \approx 2$ and $H \approx$ (500 to 1000) gauss for the microwave type-IV bursts were obtained. (auth)

34235 SOME CHARACTERISTICS OF AN S COMPONENT OF SOLAR RADIATION IDENTIFIED ON NOVEMBER 1966 ECLIPSE AT 4.28-CM WAVELENGTH. Kaufmann, Pierre (Mackenze Univ., Sao Paulo, Brazil). Solar Phys., 4: 58-66 (May 1968).

A strong S component of solar radiation was identified during the total solar eclipse of November 12, 1966. Its characteristics, as measured at 4.28 cm, were studied in terms of flux and polarization, and its spectral features were derived by the use of data from other observatories. The whole source presented approximately the typical characteristics suggested by some authors in the last few years, and further it has been shown that it could be resolved into at least two enhanced regions, one showing unpolarized radiation with a brightness temperature $T_b \approx 1.2 \times 10^6$°K, and the other showing 50% of left-handed circularly polarized radiation, with $T_b \approx 0.7 \times 10^6$°K. The source's overall characteristics favour the presence of nonthermal absorption at the emitting regions. (auth)

34236 FISSION XENON IN CHONDRITES. Sabu, D. D.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Contract AT(40-1)-3235. J. Geophys. Res., 73: 3957-64(June 15, 1968). (ORO-3235-31).

The Bruderheim chondrite contains about 1×10^{-12} cc STP ^{136f}Xe/g, and none of the ordinary chondrites studied so far seems to contain much greater amounts of fissiogenic xenon than this. From the experimental data obtained in different laboratories the following average values were secured for the Bruderheim chondrite: $^{136f}Xe = 1.06 \times 10^{-12}$ cc STP/g; $^{129r}Xe = 41 \times 10^{-12}$ cc STP/g; I = 19 ppb; U = 11 ppb. The above values yield the Pu/Xe and I/Xe decay intervals of 142×10^6 and 136×10^6 years, respectively, if the initial $^{244}Pu/^{238}U$ and $^{129}I/^{127}I$ ratios immediately after cessation of nucleosynthesis were 0.0235 and 0.0030, respectively. (auth)

34237 MICRO-SCALE STRUCTURES IN THE INTERPLANETARY MEDIUM. Burlaga, Leonard F. (Goddard Space Flight Center, Greenbelt, Md.). Solar Phys., 4: 67-92(May 1968).

The following micro-scale ($\lesssim$.01 AU) structures found in combined interplanetary magnetic field and plasma data obtained by the deep-space probe, Pioneer-6, are described and analyzed: (1) several types of simultaneous discontinuities in the magnetic field and plasma parameters; (2) at least one clear example of a transitional region (D sheet) associated with a plasma discontinuity; (3) other D sheets which give evidence of magnetic-field annihilation; (4) inhomogeneous isothermal regions in which the square of the magnetic-field intensity is proportional to the density; (5) periodic variations in the magnetic-field intensity which are associated with discontinuities in the bulk speed. It is suggested that small velocity discontinuities play a fundamental role in reducing stresses in the interplanetary medium, and that large-velocity discontinuities may give rise to waves and turbulence. (auth)

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Refer also to abstracts 34607, 34811, 35048, and 35378.

34238 (COO-1112-156) A MEASUREMENT OF THE FINE AND HYPERFINE STRUCTURES OF THE 2^3P STATES OF ^3He. German, Kenneth Raye (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 107p. Dep. CFSTI.

Thesis.

This study reports on an experimental determination of the fine and hyperfine structures of the 2^3P term of ^3He. The technique used was that of level-crossover spectroscopy. In this method the change of the angular distribution of the resonance fluorescence of atoms in a magnetic field when two excited state Zeeman sublevels cross is used to perform a measurement of the crossover field. Eighteen crossovers were observed and ten of these were measured to an accuracy of a few parts per million. The crossover signals were corrected for an asymmetry that arose from both improper optical alignment and the finite sizes of the source and detector. In addition six of the crossovers were investigated for any systematic dependence on pressure, light intensity and discharge intensity, but no shifts were found to an accuracy of about a part per million. The hyperfine constants and g value were calculated from the measured crossover fields, but not to the accuracy to which the fields could be measured. The results were $C = (-8565.07 \pm 0.63)$ MHz, $D = (-29.90 \pm 0.43)$ MHz, and $g_L/g_S = 0.4992740 \pm 0.000025$. From an extrapolation of the crossover line-width to zero pressure it was possible to obtain a value for the excited state lifetime. $\tau_n = (1.00 \pm 0.05) \times 10^{-7}$ sec. (auth)

34239 (COO-1112-160) LONG RANGE ELECTROSTATIC AND ELECTROMAGNETIC INTERACTIONS BETWEEN ATOMS. Cortez, Jose Luis Martinez (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 219p. Dep. CFSTI.

Thesis.

Nondegenerate perturbation theory is used to calculate the contribution to the interaction energy between two neutral hydrogenic atoms in the ground state due to their electrostatic interaction and the presence of an electromagnetic field in the system. Casimir and Polder have treated this problem to first order in both the electrostatic interaction potential and the radiation field (dipole–dipole approximation). Their results are verified in this calculation and extended beyond the dipole approximations to obtain interaction energies accurate to quadrupole–quadrupole orders. Corrections are obtained for each of the dipole–dipole,

dipole–quadrupole, and quadrupole–quadrupole electrostatic energies. In addition, a systematic analysis is performed to determine the coupling between the electrostatic interaction and the electromagnetic potential to give rise to the retardation contribution to the interaction energy of the system. (TSS)

34240 (COO-1112-162) RESONANCE SCATTERING OF RADIATION BY INTERACTING ATOMS. Hearn, Dwight Donald (Michigan Univ., Ann Arbor). 1968. Contract AT(11-1)-1112. 86p. Dep. CFSTI.

Thesis.

The damping theory of Heitler and Ma is applied to a system consisting of two ground-state atoms in a radiation field. Calculations include expressions for the expansion coefficients of the state vector, lifetimes of the excited atomic states, probability amplitude for the final states, and line shapes for the emitted radiation. Comparisons are made with the resonance fluorescence of a single, two-level atom and with the decay of an excited two-level atom in the presence of an identical ground-state atom. The line shape obtained is shown to be significantly different from those obtained for both one- and two-atom cases already studied. (TSS)

34241 (COO-1112-163) HYPERFINE STRUCTURE CONSTANTS OF SODIUM IODIDE. Miller, Carl Elmer (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 114p. Dep. CFSTI.

Thesis.

A molecular-beam electric-resonance spectrometer was constructed and used to study the radiofrequency spectrum of ^{23}Na ^{127}I for transitions between the hfs levels of the first rotational state. Transitions for the first four vibrational states were observed in near-zero electric and magnetic fields and the spectral lines were found to exhibit a natural line width of 2.5 kHz. All the constants necessary to describe the molecule with the $^1\Sigma$ hfs Hamiltonian were determined from the observed rf spectrum; this was not done previously for a heteronuclear, diatomic molecule in which both nuclei have quadrupole moments. Within the accuracy of the measurements, the magnetic coupling constants were found to be independent of the particular vibrational state with a maximum change for each vibrational state of ±0.06 kHz. (auth)

34242 (COO-1112-164) POLARIZABILITY MEASUREMENTS OF THE ALKALI ATOMS SODIUM, POTASSIUM, RUBIDIUM AND CESIUM. Hall, William Davis (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 155p. Dep. CFSTI.

This study reports on the experimental determination of the electric dipole polarizabilities of the alkali-metal atoms sodium, potassium, rubidium, and cesium. The measurements were made by observing the deflections of a collimated, velocity-selected atomic beam under the influence of an unhomogeneous electric field. The results are:

$$\begin{aligned}\alpha(\mathrm{Na}) &= (24.4 \pm 1.7) \times 10^{-24}\ \mathrm{cm}^3\\ \alpha(\mathrm{K}) &= (45.2 \pm 3.2) \times 10^{-24}\ \mathrm{cm}^3\\ \alpha(\mathrm{Rb}) &= (48.7 \pm 3.4) \times 10^{-24}\ \mathrm{cm}^3\\ \alpha(\mathrm{Cs}) &= (63.3 \pm 4.6) \times 10^{-24}\ \mathrm{cm}^3\end{aligned}$$

The polarizabilities measured in this experiment were found to differ from previous experimental polarizability determinations in which beam velocity analysis was not available. Subsequent experiments measuring velocity profiles and polarizabilities as a function of argon scattering gas densities have demonstrated that the discrepancy in the polarizability values arises because of the velocity-dependent scattering effect of the residual gas atoms which selectively removes low-velocity atoms from the beam, thus distorting the assumed ideal modified Maxwellian velocity distribution. The polarizability values quoted here are in good agreement with recent polarizability predictions from alkali-metal atom lifetime measurements, oscillator strength measurements, and the theoretical predictions of Sternheimer and Stone. (auth)

34243 (NP-17493) SURFACE AND VACUUM PHYSICS INDEX. Volume 3, No. 1/2(1-172). Hilsenbeck, D. (ed.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 87p. Dep.

A listing of 172 articles on various studies employing vacuum technology is presented. Subject and author indexes are included. (M.O.W.)

34244 (NP-17494) SURFACE AND VACUUM PHYSICS INDEX. Volume 3, No. 3(173-323). Hilsenbeck, D. (ed.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 88p. Dep.

A listing of 151 articles on various studies involving vacuum technology is given. Subject and author indexes are included. (M.O.W.)

34245 (TID-24491, pp 1-5) MAGNETIC MOMENT OF THE PROTON. Winkler, P. F. Jr.; Walther, F. G.; Myint, M. T.; Kleppner, D. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

An atomic hydrogen maser for operation in a magnetic field of 3500 G has been designed. The maser will be operated as an extremely narrow-band amplifier at the frequency corresponding to the electron spin-flip transition. The output level is changed when the proton spin-flip transition is stimulated. This double-resonance technique enables precise determination of the two resonant frequencies. Preliminary research work is described. (M.O.W.)

34246 (TID-24491, pp 49-56) MOLECULAR BEAM APPARATUS FOR INVESTIGATIONS OF GAS-SOLID INTERACTIONS. Yamamoto, S.; Stickney, R. E. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The apparatus is briefly described. Preliminary results for argon scattering from a silicon crystal are given. (M.O.W.)

34247 LIFETIME MEASUREMENT OF MOLECULAR STATES WITH AN ACCELERATED ION BEAM. Desesquelles, J.; Dufay, M.; Poulizac, M. C. (Faculte des Sciences, Lyon). Phys. Lett., 27A: 96-7(June 3, 1968).

Lifetime measurements of some molecular states (N_2^+ $B^2\Sigma$, N^2 $C^3\Pi$, CO^+ $B^2\Sigma$, CO_2^+ $^2\Pi_u$ and $^2\Sigma$) made using a beam of accelerated molecular ions are reported. (auth)

34248 HIGH-ENERGY SATELLITES IN THE VACUUM U. V. SPECTRUM OF Be III AND Be IV. Fraenkel, B. S. (Hebrew Univ., Jerusalem); Goldsmith, S.; Feldman, U. Phys. Lett., 27A: 111-12(June 3, 1968).

Be III resonance lines and Be IV Lyman lines were excited in an intense vacuum spark; its maximum electric current was 220 kA. Most of the Be lines have high-energy satellites of considerable intensity, whose distance from the undeviated parent line increases, in most cases, with the current. A physical explanation for the appearance of these satellites is not known. (auth)

34249 METASTABLE STATES OF MULTIPLY CHARGED IONS. Dmitriev, I. S.; Nikolaev, V. S.; Teplova, Ya. A. (Moscow State Univ.). Phys. Lett., 27A: 122-3(June 3, 1968).

The lifetimes and the number of excited states have been measured for the helium-like and lithium-like particles contained in beams of ions ^{9}Be, ^{11}B, ^{13}C, ^{14}N, and ^{16}O after passing through a thin celluloid film. (auth)

34250 INELASTIC ELECTRON SCATTERING AND INCOHERENT X-RAY SCATTERING IN SILICON AT SMALL ANGLES. Burge, R. E.; Smart, J. E. (London Univ.). Phil. Mag., 17: 1285-8(June 1968).

Calculations of the intensity of incoherent x-ray scattering (I_{inc}) from Si at small angles were made using the full Waller–Hartree expression, for comparison with the experimental results of Weinberg (1964). The agreement between calculation and experiment were poor for the entire angular range of the results (corresponding to $q = (4\pi/\lambda) \sin \phi/2$ from 0.2 to 1.3 Å^{-1}, where ϕ is the angle of scattering). Since I_{inc} appears in the formulation of inelastic electron scattering by free atoms, it is pointed out that this formulation should be applied with caution to an interpretation of small-angle electron scattering by metal films. (auth) (UK)

34251 SPECIFIC DISPLACEMENT AND DEFORMATION COEFFICIENT OF NEODYMIUM ISOTOPES. Gerstenkorn, Simon; Helbert, Jean-Marie (Faculte des Sciences, Orsay, France. CEA, Saclay, France). Compt. Rend., Ser. A and B, 266: 546-9(Feb. 26, 1968). (In French).

The specific mass effect of eight transitions belonging to the I and II spectra of Nd was determined by taking into consideration both the optical measurements made by high-resolution spectroscopy and deformation coefficients measured by nuclear methods. The specific effect thus deduced is shown to be of an order of magnitude comparable to the isotopic displacement measured in the lines; the values of C_{exp} given in the literature for the different Nd couplets should be revised. (tr-auth)

34252 CLASS OF NULL SPECTROSCOPIC COEFFICIENTS. Judd, B. R.; Wadzinski, H. T. (Johns Hopkins Univ., Baltimore). J. Math. Phys. (N. Y.), 8: 2125-30(Oct. 1967).

The irreducible representations occurring in the decomposition of the Kronecker products U × U and W × W for irreducible representations U and W of the groups G_2 and R_7 are separated into symmetrical and antisymmetrical parts. Application of the Wigner–Eckart theorem yields new selection rules and explains many of the apparently accidental zeros in the tabulation by Nielson and Koster of the reduced matrix elements of various single-particle tensor operators for the electronic configurations f^n. The method is applied in detail to the magnetic spin–spin interaction between electrons in the f shell, and the new selection rules are presented in tables. (auth)

34253 PHASE-INTEGRAL APPROXIMATION IN MOMENTUM SPACE AND THE BOUND STATES OF AN ATOM. Gutzwiller, Martin C. (Columbia Univ., New York). J. Math. Phys. (N. Y.), 8: 1979-2000(Oct. 1967).

The phase integral approximation of the Green's function in momentum space is investigated for an electron of negative energy (corresponding to a bound state) which moves in a spherically symmetric potential. If the propagator rather than the wavefunction is considered, all classical orbits enter into the formulas, rather than only the ones which satisfy certain quantum conditions, and the separation of variables can be avoided. The distinction between classically accessible and classically inaccessible regions does not arise in momentum space, because any two momenta can be connected by a classical trajectory of given negative energy for a typical atomic potential. Three approaches are discussed: the Fourier transform of the phase integral approximation in coordinate space, the approximate solution of Schrödinger's equation in momentum space by a WKB ansatz, and taking the limit of small Planck's quantum in the Feynman-type functional integral which was recently proposed by Garrod for the energy-momentum representation. In particular, the last procedure is used to obtain the phase jumps of $\pi/2$ which occur every time neighboring classical trajectories cross one another. These extra phase factors are directly related to the signature of the second variation for the action function, and provide a physical application of Morse's calculus of variation in the large. The phase integral approximation in momentum space is then applied to the Coulomb potential. The location of the poles on the negative energy axis gives the Bohr formula for the bound-state energies, and the residues of the approximate Green's function are shown to yield all the exact wavefunctions for the bound states of the hydrogen atom. (auth)

34254 STUDY OF THE PRODUCTION OF A BEAM OF METASTABLE ATOMS WITH THERMAL ENERGY. Sinda, Theodore; Watel, Guy (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 768-70(Mar. 18, 1968). (In French).

The density of metastable atoms in a gas bombarded by electrons is calculated. Numerical values are given for helium. These values are compared with measurements made with a beam of metastable atoms obtained by diffusion, beginning from a container containing helium gas bombarded by electrons. (tr-auth)

34255 EXCITATION OF THE NITROGEN MOLECULE BY AN ELECTRON BEAM IN THE ENERGY RANGE 1 TO 12 eV. Hall, Richard; Mazeau, Jean; Reinhardt, Jean (Faculte des Sciences, Paris). Compt. Rend., Ser. A and B, 266: 774-7 (Mar. 18, 1968). (In French).

With the aid of an electron gun of the R.P.D. type, associated with a collision chamber with potential wells, the structure of two excitation peaks of the N_2 molecule was determined. The resonance peak at 2.3 eV is decomposed into five secondary peaks spaced at 0.230 eV. The excitation peak at 7.77 eV was resolved into nine vibration peaks whose relative intensities are in agreement with the Franck-Condon factors of the $A^3\Sigma_u^+ - B^3\Pi_g$ transition. (tr-auth)

34256 A NEW METHOD FOR THE APPROXIMATE RESOLUTION OF THE RELATIVISTIC BOLTZMANN EQUATION. Vignon, Bernard (Faculte des Sciences, Dijon, France). Compt. Rend., Ser. A and B, 266: 594-7(Mar. 11, 1968). (In French).

From the energy forms of a particle in a proper frame of reference, the classic decomposition of the energy-momentum tensor is reviewed. The temporal self vector is interpreted and explained by a simple method for the approximate resolution of the relativistic Boltzmann equation. (tr-auth)

34257 CALCULATION OF THE POLARIZATION EFFECT ON THE HYPERFINE STRUCTURE OF Eu AND Eu^{2+}. Bagus, Paul; Picart, Jaqueline (Centre de Mecanique Ondulatoire, Paris). Compt. Rend., Ser. A and B, 266: 842-4(Mar. 25, 1968). (In French).

The hyperfine structure of the europium atom and the doubly ionized europium ion (Eu^{2+}), all in the ground state $^8S_{7/2}$, has been the object of numerous discussions. The core polarization effect of these two atoms was calculated. (tr-auth)

34258 IONIZATION LIMITS OF N I. McConkey, J. W.; Kernahan, J. A. (Queen's Univ., Belfast). Phys. Lett., 27A: 82-3(June 3, 1968).

The ionization limits of N I have been calculated using the 3d - nf transitions, and found to be 117,356.58 cm^{-1}, 117,274.25 cm^{-1}, and 117,225.35 cm^{-1} for the $3P_2$, $^3P_1$, and $^3P_0$ ground levels of N II respectively. (auth)

34259 POSSIBILITIES OF DIAGONALIZATION METHOD FOR CALCULATING THE ATOMIC SYSTEM RESONANCES. Balashov, V. V.; Grishanova, S. I.; Kruglova, I. M.; Senashenko, V. S. (Moscow State Univ.). Phys. Lett., 27A: 101-2(June 3, 1968).

The photo-ionization of He below the n = 2 threshold has been calculated within the framework of the diagonalization method. (auth)

34260 OSCILLATIONS IN THE TOTAL CROSS SECTION FOR RESONANT CHARGE TRANSFER IN $Li-Li^+$ COLLISIONS. Peek, James M.; Green, Thomas A. (Sandia Lab., Albuquerque, N. M.); Perel, Julius; Michels, H. H. Phys. Rev. Lett., 20: 1419-21 (June 17, 1968).

A simplified two-state theory is used to predict the total cross section for resonant charge transfer in $Li-Li^+$ collisions. This cross section exhibits oscillations for collision energies below 10 keV and is in qualitative agreement with preliminary experimental measurements. (auth)

34261 THEORY OF EXCITATION TRANSFER BETWEEN ATOMS BY COLLISION. Nakamura, Hiroki (Tokyo Univ.). J. Phys. Soc. Jap., 24: 1353-65(June 1968).

Excitation transfer process between atoms is investigated theoretically in the framework of the two-state approximation. Two methods are proposed with regard to the treatment of the nonlocal potential which results from the projection-operator formalism. One is a local potential approximation and the other is an extension of the method of Chadan. A new expression for the cross section is found. This formula is more accurate than the usual distorted wave one. The matrix elements of a coupling potential with respect to the wave functions of the relative motion are estimated by making use of the JWKB approximation. The new cross section formula obtained will be useful for a wide class of collision processes in which initial and final states are mutually orthogonal (auth)

34262 THE f-SUM RULE FOR "ROTATOR STRENGTHS." Rudolph, Heinz Dieter (Univ., Freiburg i. B.). Z. Phys., 211: 419-28(1968).

The concept of oscillator strengths f for the emission and absorption of radiation by the electrons of an atomic system which has lead to the familiar Kuhn-Thomas-Reiche f-sum rule has been extended to that of "rotator strengths" for a molecule approximated by a freely rotating rigid asymmetric rotator with a permanent body fixed dipole moment. As a consequence of the different type of physical system the resulting "f-sum rule for rotator strengths" holds only for what may be termed average rotator strengths (averaged over the M-degenerate sublevels). (auth)

34263 RANGE OF RECOIL ATOMS IN ISOTROPIC STOPPING MATERIALS. Biersack, Jochen P. (Hahn-Meitner-Institut, Berlin). Z. Phys., 211: 495-501(1968).

A calculation of the stopping power, range, and range straggling of low-energy atoms ($E \lesssim 1$ MeV) is reported. The computation applied the biatomic repulsive potential of Firsov and thus had to be carried out numerically. The results, however, are presented in an analytical form. Experimental checks were performed with recoil atoms. 96-keV Ra-224 atoms from the α-decay of Th-228 were used to measure the range distributions in several light gases. The fast-neutron-induced reactions, such as (n,p) or (n,α) reactions, led to recoils of higher energies (up to more than 1 MeV). Their mean ranges in polycrystalline metals or amorphous oxide layers could be obtained by measuring the fraction of radioactive recoils which had left the target surface. The experimental data are in good agreement with the theory, except at the highest energies where the observed ranges are slightly larger than predicted. (auth)

34264 NUMERICAL EXPERIMENTS ON SCATTERING OF NOBLE GASES FROM SINGLE-CRYSTAL SILVER. Oman, Richard A. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). J. Chem. Phys., 48: 3919-29(May 1, 1968).

Three-dimensional numerical experiments on the scattering of noble-gas atoms from single-crystal surfaces of silver are described. This numerical method can be very useful in determining the relative importance of different variables in the interactions although it cannot be expected to give quantitative agreement with individual cases until a better knowledge of the interatomic binding energies and the surface state is available. Most of the cases are for neon on the fcc (111) surface, but isolated cases of helium and argon on (111) and neon on (100) are included. The energies include those of effusive molecular beams from 300° to 45,000°K equivalent source temperatures (0.06 to 7.8 eV). Several interaction parameters describing mean energy and momentum exchanges and traces of the spatially resolved flux in the incident plane are given for most of the cases. Sample out-of-plane flux data and some typical data on spatially resolved energy are also given, and general trends for the rest of the data are described. The results give trapping probabilities that are much greater than those inferred from laboratory experience, and flux patterns that are significantly broader than those encountered in the experiments for the few cases that can be compared directly. The neon trends with increasing energy are quite similar to those of the Saltsburg and Smith experiments for xenon, with new effects appearing in the present results for energies higher than those of the laboratory experiments. These new effects include multiple peaks, one above and one below specular, and a broadening of the patterns with increasing incident energy. They are attributed to increased resolution of the surface atomic configuration due to deeper penetration of the potential held above the surface. The trends of the Logan, Keck, and Stickney hard-cube theory are shown in the present results at low incident energy, and the expected hard-sphere limit behavior is observed at very high incident energy, in agreement with the recent calculations of Goodman. (auth)

34265 CORRELATION OF EXCESS ENERGIES OF ELECTRON-IMPACT DISSOCIATIONS WITH THE TRANSLATIONAL ENERGIES OF THE PRODUCTS. Haney, Max A.; Franklin, J. L. (Rice Univ., Houston, Tex.). J. Chem. Phys., 48: 4093-7(May 1, 1968).

Translational energies of products of unimolecular dissociations resulting from electron impact were measured at the appearance potentials of the fragment ions. Excess energies for each process were determined from the measured appearance potentials and the known heats of formation of ground-state products and reactants. Results are compared with the predictions of the statistical theory and found to be in agreement if the classical density of states is used. Application of the method to accurate determinations of heats of formation of radicals and radical ions is demonstrated. (auth)

34266 ELECTRON-IMPACT IONIZATION CROSS SECTIONS. V. CLASSICAL CALCULATIONS AND COMPARISON. Lin, Sinshong; Stafford, Fred E. (Northwestern Univ., Evanston, Ill.). J. Chem. Phys., 48: 3885-90(May 1, 1968). (COO-1147-21).

Absolute ionization cross sections for single ionization by electron impact on gaseous atoms were calculated for elements 41–98 using the equations derived by Gryzinski based on classical theory. The results are compared with those given by Mann and with available experimental data. The discrepancies are discussed and analyzed. (auth)

34267 MEASUREMENT OF THRESHOLD ELECTRONS IN THE PHOTOIONIZATION OF H_2 AND D_2. Villarejo, Don (Univ. of Chicago). J. Chem. Phys., 48: 4014-26(May 1, 1968).

Measurements of electrons produced in the photoionization of H_2 and D_2 are reported. The experimental technique employs a differential electron-energy analyzer to detect photoelectrons produced with nearly zero initial kinetic energy ($\lesssim 0.1$ eV). By varying the photon energy a spectrum of "threshold" photoelectrons is recorded exhibiting the vibrational structure of the H_2^+ and D_2^+ ions. From these spectra values of $I(H_2)$, $I(D_2)$, $\omega_e(H_2^+)$, $\omega_e(D_2^+)$, $\omega_e x_e(H_2^+)$, and $\omega_e x_e(D_2^+)$ are derived. In favorable cases the relative vibrational transition probabilities are also reported and compared with theoretical predictions as well as with other experiments. Some disagreements are noted in comparing the results obtained by this method with theoretical Franck–Condon factors based on potential curves appropriate to nonrotating molecules. It is suggested that the vibration–rotation interaction should be taken into account in calculations pertaining to electronic transitions in light molecules. (auth)

34268 ENERGY DEPENDENCE OF CHARGE-TRANSFER REACTIONS IN THE THERMAL AND LOW-ELECTRON-VOLT REGION. Wolf, Fred A.; Turner, B. R. (Gulf General Atomic Inc., San Diego, Calif.). J. Chem. Phys., 48: 4226-33(May 1, 1968).

A method is presented for extrapolating to lower energies the cross sections for charge transfer which were measured by beam techniques for incident kinetic energies greater than 1 eV. The method combines the Rapp and Francis resonance charge-transfer theory with the Langevin capture model, and is based upon a simple superposition of the "noncapture resonance" and "capture resonance" probabilities resulting in charge transfer. Also illustrated is a method for including nonrectilinear orbits in the Rapp and Francis model. Application of the theory to the negative-ion charge-transfer reactions O^-, O_2^-, O_3^-, and OH^- with NO_2; the positive-ion charge-transfer reactions O^+, O_2^+, N^+, and N_2^+ with NO; and N^+ with O_2 is given, and comparisons with existing experimental data are made. The method appears to be a reasonable approximation provided that the relative probability of the charge-transfer channel emerging from the capture-formed complex is independent of the relative kinetic energy of the reactants. (auth)

34269 PERMEABILITIES AND TRANSMISSION COEFFICIENTS FOR VARIOUS ISOTOPIC REACTIONS OF THE TYPE $H + H_2 = H_2 + H$. Mortensen, Earl M. (Univ. of Massachusetts, Amherst). J. Chem. Phys., 48: 4029-39(May 1, 1968).

Permeabilities for the reaction $H + H_2 = H_2 + H$ and its isotopic substitutions were obtained for a linear collision by numerically solving the Schrödinger equation. Bending corrections were applied to account for the bending motions of the activated state. Transmission coefficients were calculated from the permeabilities at various temperatures. From the results reported here it appears that the zero-point energy of the activated state for reactions in which a light atom such as hydrogen is transferred cannot be obtained from the usual normal-mode treatment using the curvature of the surface at the saddle point. (auth)

34270 ENERGY DEPENDENCE OF ENERGY PARTITION IN PRODUCTS OF DIRECT REACTIONS: CROSSED-BEAM STUDIES AND A NEW MODEL. Hierl, P.; Herman, Z.; Kerstetter, J.; Wolfgang, R. (Yale Univ., New Haven. Univ. of Colorado, Boulder). J. Chem. Phys., 48: 4319-20(May 1, 1968).

Findings on the distribution of the reaction energy between internal and translational modes of the products of direct reactions, and on the dependence of this distribution on initial kinetic energy, are reported. Results on the systems $Ar^+ + D_2 \rightarrow ArD^+ + D$ and $Ar^+ + H_2 \rightarrow ArH^+ + H$ are presented. (TSS)

34271 APPROXIMATION METHOD IN CLASSICAL SCATTERING BY SCREENED COULOMB FIELDS. Lindhard, J.; Nielsen, Vibeke; Scharff, M. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd., 36: 31p(1968).

A comprehensive approximation formula for classical scattering of fast ions by atoms is presented. The simplifications and the errors resulting from the use of a Thomas–Fermi type potential in scattering calculations are discussed. The accuracy of classical mechanics in such scattering problems is treated briefly. Scattering by power-law potentials for low-angle deflections is studied and a wide-angle extrapolation is derived in terms of a one-parameter formula. The formula is applied to Thomas–Fermi potentials, where the reduced scattering cross section is found numerically as a function of a single scattering parameter. The stopping cross section is obtained as a function of reduced energy. The magic formula is derived, which leads to easy estimates of scattering in any potential, and scattering by several types of screened potentials is compared. Comparison is also made with more precise computations of scattering. (auth)

34272 SOME APPROXIMATIONS OF THE PROFILES OF SPECTRAL LINES EMITTED BY AN OPTICALLY THIN LAYER OF PLASMA. Preobrazhenskii, N. G. Opt. Spectrosc. (USSR) (Engl. Transl.), 24: 5-7(Jan. 1968).

Translated from Opt. Spektrosk., 24: 12-18(Jan. 1968).

Several expressions for the profile of a spectral line not distorted by reabsorption in the plasma layer are discussed. Lines with the quadratic and linear Stark effects in the presence of Doppler broadening are considered. The asymmetric profiles are described by means of specially modified Student distributions. (auth)

34273 PENETRATION OF ELECTRONS WITH MODERATE ENERGIES INTO A SOLID. Smirnov, L. A.; Rumsh, M. A. (Zhdanov State Univ., Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 9: 2653-4(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3361-2(Nov. 1967).

An x-ray method is proposed for obtaining new information on the penetration of electrons with energies from several keV to several tens of keV into a massive solid. A device was constructed, which combined a demountable x-ray tube with an x-ray spectrometer and made it possible to measure the Cu Kβ line in the 0 to 40° angular range. Results agreed with theoretical calculations using Makhov's formula. (A.G.W.)

34274 ZEEMAN EFFECT INVESTIGATIONS IN Er I. Heilig, K.; Kircher, O. (Technische Univ., Hanover). Z. Phys., 212: 243-7(1968). (In German).

Zeeman effect investigations in Er I were made in the 3000- to 5000-Å range at field strengths of about 26 kOe. A total of 74 g_J values were determined. The g_J values for 11 levels of the configuration $4f^{11}\,5d\,6s^2$ and for 4 levels of $4f^{12}\,6s^2$ are compared with theoretical values calculated by other authors. (auth)

34275 HARMONIC OSCILLATOR IN ATOMIC AND MOLECULAR PHYSICS. Moshinsky, M.; Novaro, O. (Univ., Mexico City). J. Chem. Phys., 48: 4162-80(May 1, 1968).

Harmonic oscillator states have played an important role in nuclear structure. This has encouraged nuclear physicists to develop elaborate mathematical techniques, based on group theory, for dealing with n-particle states in the harmonic oscillator (ho) potential. The n-particle ho states are used in this article to represent the electronic wavefunctions. The matrix elements of the physical Hamiltonians with respect to the n-particle ho states are explicitly evaluated. Applications to atoms and diatomic molecules of up to four electrons are given as well as a discussion of H_3^+. An analysis for closed shells in the ho potential, where the matrix elements can be reduced to those of one or two particles, is also given. The validity of the approximations involved and the possibilities of the method are discussed critically. (auth)

34276 FIRST EXCITED $^1\Sigma_g^+$ STATE OF THE HYDROGEN MOLECULE AND ITS ISOTOPES. Boye, Robert J. (Johns Hopkins Univ., Baltimore). J. Mol. Spectrosc., 26: 36-45(May 1968).

A complete theoretical analysis of the first excited $^1\Sigma_g^+$ state of the hydrogen molecule is presented. A linear variational method based on a James and Coolidge wave function was used to compute a potential curve for the electronic motion. The potential curve obtained has two minima. A 24-term wave function gave a potential minimum at R = 1.9 atomic units of −0.71749 a.u. as compared to the experimental value of −0.7181 a.u. A minimum energy of −0.70532 a.u. was obtained at R = 4.3 a.u. as compared to Davidson's calculated value of −0.70067 au at R = 4.35 au. Using this potential curve vibrational and rotational levels were then computed for the hydrogen molecule and its isotopic species. The results for H_2, D_2, and T_2 were compared with experimental values. The levels below the potential barrier were classified as belonging to the separate minima by examining the rotational differences and the wave functions for the nuclear motion. Above the barrier the probability density was approximately the same for both minima. (auth)

34277 STUDY OF PULVERIZATION OF METALLIC THIN LAYERS BY MOLECULAR JETS OF ENERGY BETWEEN 1000 AND 10,000 eV. Devienne, F. Marcel; Roustan, Andre (Laboratoire Mediterraneen de Recherches Thermodynamiques, Nice). Entropie, No. 20, 9-18(Mar.-Apr. 1968). (In French).

Radioactive isotopes were used under thin layer shapes produced by thermal evaporation; these thin layers are bombarded with molecular beams of 1- to 10-keV energies. After a description of the experimental equipment and of the measurement method, particularly the measurement of the molecular beam intensities and of the extraction rate, some test results are given. (auth)

34278 INDUCED SYNCHROTRON RADIATION. Schoenauer, Horst (Technische Hochschule, Vienna). Z. Phys., 213: 1-20 (1968). (In German).

The conditions for laser action of an ensemble of relativistic electrons moving under circumstances comparable with those in a circular accelerator are investigated. The possibility is found to exist in principle, but the required current density of the electron beam is to be extremely high for interesting frequencies. Nevertheless, some astrophysical conclusions can be drawn. (auth)

34279 CHEMICAL INTERACTION OF POSITRONIUM ATOMS WITH CHLORINE. Gol'danskii, V. I.; Mokrushin, A. D. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 93-8 (Jan.-Feb. 1968). (In Russian).

The chemical interaction of positronium atoms with chlorine was investigated by the method of the angular correlation of annihilation quanta. The results obtained are explained well under the assumption that the bimolecular reaction of Ps with Cl_2 proceeds according to the scheme $Ps + Cl_2 \rightarrow PsCl + Cl$, and is a threshold reaction. The value 4×10^{-9} cm^3 sec^{-1} was obtained for the velocity constant of this reaction. An evaluation of the inelastic scattering cross section of Ps atoms on O_2 molecules was given as 3×10^{-19} cm^2. A comparison was made of the velocity constants of the reactions of Ps and H atoms with chlorine. (tr-auth)

34280 SMALL-ANGLE RUTHERFORD SCATTERING OF H AND H^+ BY He, Ne, AND Ar. Dose, V. (Univ., Zurich). Helv. Phys. Acta, 41: 261-3(May 15, 1968).

The relationship between reduced scattering angle $\tau = \theta E$ and impact parameter ρ in the scattering of H^+ and H by He, Ne, and Ar targets has been calculated in the range $.05 \leq \rho \leq 1.5$. The results show that the additional screening in the case of the H projectile causes a considerable decrease in the impact parameter, thus leading to lower cross sections in the small-τ range. (auth)

34281 COLLISIONS OF HYDROGEN WITH RARE GASES. I. POLARIZATION OF LYMAN-α RADIATION. Dose, V.; Gunz, R.; Meyer, V. (Univ., Zurich). Helv. Phys. Acta, 41: 264-8(May 15, 1968).

The polarization of Lyman-α radiation in collisions between hydrogen and He, Ne, and Ar has been measured in the energy range from 3 to 55 keV. The low-energy data are taken using deuterium. In all three cases positive polarizations are found over the entire energy range. The absolute values of the polarization are not accurate enough to correct total cross-section measurements in which the emitted radiation is observed under an angle of 90° with respect to the beam direction. (auth)

34282 COLLISIONS OF HYDROGEN WITH RARE GASES. II. ABSOLUTE TOTAL CROSS SECTIONS FOR EXCITATION OF LYMAN-α RADIATION. Dose, V.; Gunz, R.; Meyer, V. (Univ., Zurich). Helv. Phys. Acta, 41: 269-73(May 15, 1968).

Total cross sections for excitation of Lyman-α radiation in collisions of hydrogen with He, Ne, and Ar have been measured in the energy range 3 to 55 keV. The low-energy data have been taken with a deuterium beam. Absolute values of the cross sections are obtained by comparison with the known excitation cross sections of Lyman-α radiation in H^+−He collisions. (auth)

34283 CHARGE EXCHANGE OF LOW-ENERGY PROTONS IN POTASSIUM VAPOR. Schmelzbach, P. A.; Gruebler, W.; Koenig, V.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta, 41: 310-12(May 15, 1968).

One- and two-electron charge exchange for a proton beam incident upon potassium vapor has been investigated in the energy region from 2.5 to 22 keV. Charge components and cross sections were determined. (auth)

34284 HYPERFINE STRUCTURE AND LIFETIME OF THE $7^2P_{3/2}$ STATE OF ^{85}Rb AND ^{87}Rb. Bucka, H.; Zu Putlitz, G.; Rabold, R. (Univ., Heidelberg). Z. Phys., 213: 101-18(1968). (In German).

The hyperfine structure splitting of the $7^2P_{3/2}$ state of ^{85}Rb and ^{87}Rb was measured with optical double resonance. The following hfs interaction constants were obtained: Rb^{85}: $A_{7p}^{85} = 3.71(1)$ MHz; $B_{7p}^{85} = 3.68(8)$ MHz. Rb^{87}: $A_{7p}^{87} = 12.57(1)$ MHz; $B_{7p}^{87} = 1.71(3)$ MHz. These values yield quadrupole moments of $Q_{7p,hfs}^{85} = +0.316(7)$ barn and $Q_{7p,hfs}^{87} = +0.147(2)$ barn, which are reduced by application of the Sternheimer correction to $Q_{7p}^{85} = +0.267(6)$ barn and $Q_{7p}^{87} = +0.124(2)$ barn. The averaged ratio of the uncorrected values of Q_{hfs} in the 5p and 7p $^2P_{3/2}$ state is $Q_{5p,hfs}/Q_{7p,hfs} = 1.07(3)$. This has to be compared with the correction factors for polarization of the core of electrons by the nuclear quadrupole moment $(1 - R)_{5p}$ $(1 - R)_{7p} = 1.07$. The agreement between the measured and calculated ratio indicates a net antishielding of the nuclear quadrupole moments of rubidium by the core of electrons as was predicted by Sternheimer. The lifetime of the $7^2P_{3/2}$ state of the Rb I spectrum is: $\tau(7^2P_{3/2}, Rb) = 2.4(2) \times 10^{-7}$ sec. (auth)

34285 CROSSED-BEAM STUDIES OF ION–MOLECULE REACTION MECHANISMS. Herman, Z.; Kerstetter, J.; Rose, T.; Wolfgang, Richard (Yale Univ., New Haven). Discuss. Faraday Soc., No. 44, 123-36(1967).

Techniques were developed for the crossed-beam study of certain simple reactions as a function of energy. An approximately monoenergetic ion beam was crossed with a thermal molecular beam and ionic products characterized as to their nature, angular distribution, translational energy and, by difference, internal energy. Such measurements may be made as a function of energy available in the center-of-mass system in the range 0.1 to 25 eV. Initial studies using this method were made on the reactions $Ar^+ + D_2 \rightarrow ArD^+ + D$ and $N_2^+ + D_2 \rightarrow N_2D^+ + D$. Contrary to earlier suggestions, their mechanisms are not dominated by an intermediate of relatively long life. Instead, even at the lowest energies, these reactions appear to be "direct", in that the collision complex has a lifetime comparable to, or less than, one molecular rotation. The results suggest a new general model for direct reactions which postulates dominance by long-range forces. This predicts product energies and angular distributions well in accord with experimental findings. At lowest reactant energies part of the energy of reaction appears as translation, but as the incident velocity increases the situation reverses and there is conversion of translational to internal energy. At highest reactant energies, spectator stripping is approached as a limiting case. Interpretation of the data by this model provides reasonable estimates for the critical internuclear distance in the intermediate state. (auth) (UK)

34286 DEPTH DISTRIBUTION MEASUREMENTS USING BOMBARDMENT-ENHANCED SOLUBILITY. Jech, C. (Inst. of Physical Chemistry, Prague). Phys. Status Solidi, 27: 573-7 (June 1, 1968).

A method is described, which enables thin, uniform layers to be sectioned off from the surfaces of insulators and semiconductors. It is based on the formation of bombardment-induced disorder in a layer of definite thickness by low-energy ion bombardment and subsequent dissolving the disordered layer in a suitable solvent. The thickness of the layer thus removed after various times and conditions of ion bombardment is determined for silicon and mica using neutron-activation analysis. The method is applied for determining the depth distribution of radon decay products injected by recoil from a planar radon source into mica. (auth)

34287 LONGITUDINAL DEPOLARIZATION OF A BEAM OF SPIN-½ PARTICLES WITH ENERGY LOSS. Braicovich, L. (Istituto di Fisica del Politecnico, Milan). Nuovo Cim., 55A: 609-17(June 21, 1968).

The problem of the calculation of the longitudinal depolarization of a beam of spin-½ particles is approximately treated in the case in which the energy loss of the particles cannot be neglected. The picture suggested is based on a heuristic extension of an equation given in a preceding work, in which the energy loss of the particles is neglected. The suggested theory is also specialized to the case of a beam of electrons, on the basis of a suitable approximate description of the scattering of polarized electrons on target bound electrons; this last case is treated in detail in order to give a theoretical basis to the discussion carried out by Braicovich, De Michelis, and Fasana of the results of an electron depolarization experiment. (auth)

34288 FINE STRUCTURE MEASUREMENTS IN THE ENERGY ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS FROM A (110) FACE OF COPPER. Appelt, G. (Physikalisch-Technisches Institut, Berlin). Phys. Status Solidi, 27: 657-69(June 1, 1968).

The energy angular distribution of secondary electrons from a (110) face of copper in the (010) azimuth is measured by a dynamical method. The plots exhibit numerous fine structure maxima. It can be shown that the maxima corresponding to all theoretically possible directions of reciprocal lattice vectors up to the 46th order may be found in every measurement; taking the whole results, maxima corresponding to directions of reciprocal lattice vectors up to the 148th order may be detected continuously. The correlation of the maxima to the crystal structure yields experimental values of the refractive index, which depends on the energy of the secondary but is independent of the energy of the primary electrons. By means of this refractive index it is possible to determine the energy band of excited states above the vacuum level in the (010) direction of the wave vector, except an integration constant. (auth)

34289 POLARIZATION AS A FUNCTION OF THE MAGNETIC FIELD OF THE LIGHT EMITTED BY OPTICAL RESONANCE OF THE 2,288 A RADIATION BY THE 114 AND 111 ISOTOPES OF CADMIUM. Spitzer-Aronsohn, Martha (Coll. de France, Paris). Compt. Rend., Ser. A and B, 266: 913-16(Apr. 1, 1968). (In French).

The results are given of an experimental study of the polarization as a function of the magnetic field of the light emitted by optical resonance of the 2.288 Å radiation by ^{114}Cd and ^{111}Cd. This study was made with narrow beams and the photographic method. The results are compared with the numerical results from theoretical formulas. (tr-auth)

34290 PRODUCT ENERGY AND ANGULAR DISTRIBUTIONS FROM THE REACTION OF N_2^+ WITH ISOTOPIC HYDROGEN MOLECULES. Gentry, W. R.; Gislason, E. A.; Lee, Yuan-tseh; Mahan, B. H.; Tsao, Chi-wing (Univ. of California, Berkeley). Contract W-7405-eng-48. Discuss. Faraday Soc., No. 44, 137-45 (1967). (UCRL-17674).

The energy and angular distributions of N_2H^+ and N_2D^+ formed when a beam of N_2^+ passes through a scattering cell containing H_2, D_2, or HD were measured at relative kinetic energies ranging from 2.3 to 11.6 eV. From some experiments, intensity contour maps that show the complete product velocity vector distribution in the centre-of-mass system were generated. Although backward recoil scattering occurs at all energies, most products are scattered forward in the centre-of-mass system. The shape and position of the forward scattered product peak are largely consistent with the stripping model modified to account for target motion. (auth) (UK)

34291 MULTIPLY CHARGED IONS PRODUCED FOLLOWING THE X-RAY IONIZATION OF XENON. Bayliss, John Temple. Charlottesville, Va., Univ. of Virginia, 1967. 113p.
Thesis.

A Paul-type mass spectrometer was used to measure the relative abundances of multiply charged ions produced following the ionization of xenon by x rays. V and Ti x-ray tube targets were used with a Ti x-ray filter and Cr and V targets were used with a V filter in order to distinguish the distribution of multiply charged ions resulting from initial vacancies in the L_3 subshell from that resulting from initial vacancies in the L_2 subshell. The average charge of the ions resulting from initial L_2 vacancies was found to be 9.15 ± .18. For initial L_3 vacancies the average charge was 8.65 ± .09. (Disser. Abstr.)

34292 ELECTRON VELOCITY DISTRIBUTION IN A PARTIALLY IONIZED GAS UNDER THE ACTION OF ELECTRIC AND MAGNETIC FIELDS. II. Lo Surdo, C.; Zampaglione, V. (CNEN, Frascati, Italy). Nuovo Cim., 55B: 315-34(June 11, 1968).

In a previous paper the problem of finding the electron distribution function (d.f.) in a partially ionized gas, under the action of electric and magnetic fields, was reduced to the solution of a nonlinear, integro–differential equation. This was done by assuming the inelastic interaction effects to be unimportant. A general analysis of these effects is provided including collisional and radiative excitation and (simple) ionization, and their inverse. Their influence on the electron d.f. is then reduced to the introduction of another suitable integral term in the above equation, which is now being solved by iterative direct methods together with the balance equations for the excited atoms. (auth)

34293 A LABORATORY INVESTIGATION OF THE SPECTRA OF HIGHLY IONIZED SULFUR, CHLORINE, ARGON, POTASSIUM, AND CALCIUM. Deutschman, William Alan. Boulder, Colo., Univ. of Colorado, 1967. 148p.
Thesis.

The results and applications of a laboratory investigation of ultraviolet lines that might be observed in the solar spectrum are reported. One hundred and two new lines are identified in the spectra of S IX, S X, S XI, S XII, Cl IX, Cl X, Cl XI, Cl XII, Cl XIII, Ar X, Ar XI, Ar XII, Ar XIII, K XI, K XII, and K XIII. The identified transitions occur between the $2s^22p^n$ and $2s2p^{n+1}$, n = 1–5, configurations in the boron, carbon, nitrogen, oxygen, and fluorine isoelectronic sequences. Energies are computed for the levels occurring in these configurations. Three investigations are conducted using the observed data. New, more accurate energy levels and wavelengths are extrapolated for the K XIII, K XIV, Ca XIII, Ca XIV, and Ca XV ions that are not observed in the laboratory spectra. The forbidden coronal lines are studied and one line in the solar spectrum, the $^3P_1-^3P_2$ transition in Ar XIII, is shown to be incorrectly identified. Finally, the solar ultraviolet lines are compared with the laboratory lines in an attempt to confirm existing identifications and to seek new ones. No new lines were identified, but the S IX and S X lines previously identified with extrapolated data were checked with the newly identified lines. A brief discussion of image formation in a grazing-incidence spectrograph is included in this thesis. The theta-pinch light source and methods for introducing impurity elements are described. Line identification procedures are formulated and the criteria used to confirm the identifications are considered. (Disser. Abstr.)

34294 RELATIVE OSCILLATOR STRENGTHS FOR LINES OF Tb I. Corliss, C. H. (National Bureau of Standards, Washington, D. C.). J. Quant. Spectrosc. Radiative Transfer, 8: 1185-91(May 1968).

Relative oscillator strengths are derived for 250 lines of the first spectrum of terbium by using the relative intensities from the tables of spectral-line intensities by Meggers, Corliss, and Scribner and the line classifications by Klinkenberg. (auth) (UK)

Cosmic Radiation

Refer also to abstracts 34469, 34847, 34866, and 34945.

34295 MEASUREMENT OF COSMIC RAYS IN A PERIOD OF MINIMUM SOLAR ACTIVITY WITH THE AID OF SIMULTANEOUS SPARMO FLIGHTS. Heristichi, Dj. (Laboratoire de Physique Cosmique, Meudon, France). Ann. Geophys., 24: 137-46(Jan.-Mar. 1968). (In French).

In the SPARMO program several balloon flights were performed at different geomagnetic latitudes during the last period of solar minimum with standard detectors. Using the telescope counting rate it is possible to find simultaneously the intensity and the angular distribution of charged particles in the atmosphere by an iteration method. The observed angular distribution is in good agreement with some direct measurements. The integral energy spectrum of primary protons during the solar minimum is derived by extrapolation of the intensity to the top of the atmosphere. The notion of "penetration length" was introduced to determine at what atmospheric depth a primary particle is still observed by its secondary charged particles. It is shown that this "penetration length" is smaller than the range. The latitude effect of atmospheric x rays was determined by comparing the counting rate of a single counter and a telescope. On the other hand, the conservation of the x-ray spectrum established previously at the middle latitudes is confirmed for all latitudes. The average multiplicity factor which gives the number of x-rays that are produced by one primary particle of medium energy varies by a factor 5 between polar and equatorial regions. (auth)

34296 COSMIC-RAY FLUXES AT DIFFERENT ZENITH ANGLES. Ghosh, Samir; Sengupta, Sima (Presidency Coll., Calcutta). Indian J. Phys., 41: 788-9(Oct. 1967).

A four-fold G-M counter telescope was used for the measurements and the fluxes were recorded by a four-fold coincidence circuit. The probabilities of fluxes at different zenith angles were plotted. (M.H.R.)

34297 SOME DYNAMIC PHENOMENA IN DIURNAL COSMIC-RAY VARIATION. Pankratov, A. K.; Stepanyan, A. A. (Crimean Astrophysical Observatory, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 424-5(1967).

Translated from Geomagn. Aeron., 7: 528-9(1967).

Phase jumps are discussed in terms of diurnal cosmic-ray variations. (M.O.W.)

34298 METHOD OF ALLOWING FOR ATMOSPHERIC EFFECTS IN THE STUDY OF THE STELLAR-DIURNAL VARIATIONS OF AIR SHOWERS. Efimov, N. N. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 428(1967).

Translated from Geomagn. Aeron., 7: 532(1967).

A method is proposed for determining α_h and α_T from solar diurnal and antistellar variations, ωAS, Δh, and ΔT, assuming that these variations are of atmospheric origin only. (M.O.W.)

34299 MEASUREMENTS OF ABSORBED RADIATION DOSES DURING FLIGHT IN SATELLITES. Makhmudov, B. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No, 2, 11-16(Mar.-Apr. 1968). (In Russian).

A brief review is given of the results obtained on cosmic radiation doses measured during satellite flights. Tabulated data are given on the dose inside the satellite per 24 hr at elevations from 300 to 1500 km. (R.V.J.)

34300 DETERMINATION OF THE PARAMETERS OF INTERPLANETARY MAGNETIC FIELD INHOMOGENEITIES FROM THE ANISOTROPIC STAGE OF COSMIC-RAY BURSTS. Shishov, V. I. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 364-7(1967).

Translated from Geomagn. Aeron., 7: 451-5(1967).

A kinetic equation in the Fokker-Planck approximation is used to analyze the anisotropic stage of cosmic-ray bursts in the region of energies $\sim 10^9$ eV. Simple approximate formulas are obtained, relating intensity in various directions. The theoretical results are compared with experimental data on the bursts of May 4 and 12 and November 15, 1960, and the effective time of the mean free path is determined for various distances from the sun. (auth)

34301 DEPENDENCE OF THE DIFFUSION COEFFICIENT OF SOLAR COSMIC RAYS ON THE DISTANCE FROM THE SUN. Miroshnichenko, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 368-72(1967).

Translated from Geomagn. Aeron., 7: 456-62(1967).

A modified diffusion model is examined where the dependence of the diffusion coefficient on the energy of solar particles and the distance from the sun is taken into account. The hardness spectrum of solar cosmic rays is assumed to be a power spectrum and the source is assumed to be an instantaneous point source. The solution of the generalized diffusion equation obtained is used to analyze the expected time variations of the spectrum of solar particles near the earth. The dependence of the diffusion coefficient on the distance from the Sun is investigated and the problem of the diffusion rate is examined. Arguments are advanced in favor of a closed model of interplanetary space. An estimate is made of the dimension of the region of space on which information can be obtained from measurements of solar cosmic rays near the earth. (auth)

34302 INTERACTION BETWEEN ULTRA-HIGH ENERGY COSMIC RAYS AND PHOTONS IN THE UNIVERSE. Konstantinov, B. P.; Kocharov, G. E.; Starbunov, Yu. N.; Zhuravlev, O. S. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett., 27B: 30-3(May 27, 1968).

The interaction between ultrahigh-energy cosmic rays and isotropic background of photons in the universe is considered. It is shown that the shape of spectrum of cosmic rays in the ultrahigh-energy region contains the information about the time of propagation of cosmic rays and the dependence of cross section of photopion reactions on energy. (auth)

34303 PERTURBATIONS OF THE NEUTRON COMPONENT OF COSMIC RAYS DURING THE INITIAL PHASE OF FORBUSH DECREASES. Stensland, Bengt (Uppsala Univ.). Ark. Geofys., 5: 369-85(1968).

A scrutiny was made of data of the years 1957 through 1962 of neutron monitor stations, paired to form ratio series. It was revealed that the distribution of the neutron component of the cosmic rays became characteristically perturbed when a sudden commencement of a magnetic storm associated with a Forbush decrease occurred. A study of radios having a common denominator but different nominators showed that the magnitude of such disturbances is, as a rule, great when the cutoff rigidity at the station is low and decreases as the rigidity increases. Analyses of radio series revealed excess influx at LT 18.23 ± 0.14 before ssc, when associated with a FD, and that the phase of the diurnal variation of the registrations shifted counter-clockwise about 2 hrs over the time of ssc. A source of this effect might be either a field deformation, a spectrum weakening, or an excess influx from the direction of the Sun. A seasonal and a daily variation of the effect suggests that the disturbances are most prominent in the ecliptic plane, and that the day side of Earth is the target of the disturbing agent. (auth) (Sweden)

34304 AIR PRESSURE DEPENDENCE OF COSMIC-RAY INTENSITY. Martinelle, Sten (Uppsala Univ.). Tellus, 20: No. 1, 179-97(1968).

A general regression model is derived which described the dependence of the cosmic-ray neutronic component on the air pressure. As the residuals are correlated the ordinary least-squares method is not the best one to estimate the pressure effect. Alternative methods are discussed. Five methods are used to estimate the pressure coefficient at Uppsala during the years 1957 to 1964. It shown that a modified two-station method gives the best result and also that there exists a solar cycle dependence of the pressure coefficient. (auth) (Sweden)

34305 STUDIES OF THE RECOVERY PART OF COSMIC-RAY STORMS. Oestman, Bo (Uppsala Univ.). Ark. Geofys., 5: 387-99(1968).

Several cosmic-ray storms of the years 1957 through 1963 were treated in this study of the recovery after a decrease in the cosmic-ray intensity. An analysis is accomplished using the recovery constant and smoothing of the data. The recovery constant is a measure of the rate of the recovery after a cosmic-ray storm. The results show that for several storms there is no recovery constant which is valid for the whole recovery. On the contrary, however, there are possibilities to prove that small decreases in the recovery of some big storms do not change the recovery constant which is valid for the whole recovery. There exist differences in the recovery constants calculated from data recorded by separate meson detectors for some storms. There are also differences in the recovery constants of the meson part and that of the nucleonic part. (auth) (Sweden)

34306 ENCHANCED INTENSITY TIME VARIATIONS IN THE PREDECREASE REGION OF FORBUSH DECREASES. Sandstroem, Arne Eld; Thayarnyong, Somchai (Uppsala Univ.). Ark. Geofys., 5: 401-19(1968).

Three separate methods were employed for studies of the diurnal variation close before and during the early part of Forbush decreases. The methods are based upon a separation between daily variations and the variation of the average intensity level before and during the decrease. One of the methods is applicable in cases when a variation with diurnal periods is present only during a few hours. In cases displaying a diurnal variation considerably above the normal it is possible to determine phases and amplitudes within reasonable limits of error. Six such events were treated, selected from the cosmic ray storms during the epoch of high solar activity 1957-1959. Five of these events display an enhanced diurnal variation with phase corresponding to anisotropies in the afternoon direction. In one event the phase turned out to be inversed, thus corresponding to an anisotropy in the morning direction. The amplitudes were of the order of 1.0 to 1.6%. (auth) (Sweden)

34307 COSMIC RAYS FROM NEARBY SUPERNOVAE: BIOLOGICAL EFFECTS. Laster, Howard (Univ. of Maryland, College Park); Tucker, W. H.; Terry, K. D. Science, 160: 1138-9(June 7, 1968).

Terry and Tucker (Science 159, 421(1968)) speculated that cosmic radiation from exploding supernovae could have caused the extinction of many animals on Earth in geologic times. Their assumption on the travel time of cosmic rays is challenged and it is concluded that the radiation would arrive at the Earth spread out over a much longer time span than they allowed for. A reply by Terry and Tucker in support of their original estimates is included. (W.D.M.)

34308 DISCREPANCY BETWEEN MEASURED AND CALCULATED COSMIC-RAY SPECTRA IN THE ATMOSPHERE. Jabs, Arthur (Univ., Kiel). Z. Phys., 212: 222-34(1968).

The flux of nucleons, pions, and muons in the energy range 1 to 1000 GeV and in atmospheric altitudes of 0 to 48 km was calculated to a high degree of accuracy and without gross simplifications. Thus, a discrepancy indicated already in 1964 by Brooke, Hayman, Kamiya, and Wolfendale has been firmly established. The discrepancy means that it has proved impossible to derive the measured nucleon and muon spectra near sea level from the measured primary nucleon spectrum unless the primary spectrum is reduced by a factor of about 2.5 or the high-energy collision models commonly used are changed. The latter would mean that the fraction of energy lost by the nucleon in a collision is passed over to the muon component to a minor extent than so far accepted, and this may be achieved in two ways: either the ratio of collision energy passed on to the electron—photon component to the energy passed on to the pion—muon component is increased in favor of the former, or about 10 to 20% of the collision energy is passed on to unspecified particles which do not contribute appreciably to the hard and weak components of cosmic rays. The possibility is discussed that the missing fraction of 10 to 20% is spent in production of baryon—antibaryon pairs. (auth)

34309 IMPROVED MODEL FOR COSMIC-RAY PROPAGATION. Noerdlinger, Peter D. (Univ. of Iowa, Iowa City). Phys. Rev. Lett., 20: 1513-16(June 24, 1968).

A model for cosmic-ray propagation derived by Jokipii is modified to take into account particle mirroring. The diffusion coefficient for particles of known velocity and rigidity is then determined by a limited portion of the field spectrum, instead of being affected by all frequencies above a limiting one. (auth)

34310 A STUDY OF LOW-ENERGY GALACTIC COSMIC RAYS FROM 1961 TO 1965. Teegarden, Bonnard John. College Park, Md., Univ. of Maryland, 1967. 120p.

Thesis.

The results from a series of balloon flights beginning in 1961 and ending in 1965 are presented. Measurements of the cosmic-ray intensity were made using a dE/dx and E detector sensitive to energies from 15 to 80 MeV/nucleon. The early balloon flights provided design information and also aided in the development of data handling techniques for later satellite versions of the detector which have been on IMP's I, II, and III and OGO's I and II. Proton and helium intensities at 85 MeV/nucleon are presented for the five-year period covered by the balloon flight series. The behavior of the proton to helium ratio as a function of time is discussed within the framework of Parker's model for the solar modulation of cosmic rays. In 1965 a modified version of the dE/dx and E detector with an extended energy range was flown for the first time. A cosmic-ray helium spectrum from 60 to 500 MeV/nucleon measured by this detector is presented. The change in proton and helium intensities in this energy region from 1963 to 1965 is examined and compared with the results predicted by the various special cases of Parker's model. A totally empirical atmospheric secondary proton spectrum is derived, based on simultaneous balloon and satellite measurements. This spectrum is compared with the secondary spectrum obtained from a nuclear emulsion measurement and the differences are discussed. Using the empirical secondary spectrum, an upper limit for the re-entrant albedo at Sioux Falls was obtained which is significantly less than values reported by other observers. A measurement of the intensities of secondary deuterium and tritium was made in 1965. Using these results, a value was obtained for the global average production of tritium in the Earth's atmosphere. The implications of this result regarding the problem of tritium balance in the atmosphere are discussed. (Diss. Abstr.)

34311 ANALYSIS OF DAILY VARIATIONS OF COSMIC RADIATION. Jost, P.; Debrunner, H. (Univ., Bern). Helv. Phys. Acta, 41: 327-32(May 15, 1968). (In German).

The correlation between the daily variation of the cosmic-ray nucleonic component and the geomagnetic activity K_p has been studied. Neutron monitor data of Climax, Deep-River, Jungfraujoch, Uppsala, and Zugspitze from 1957 to 1960 have been used. Results show a trend to a positive correlation between the amplitude of the first harmonic of the daily variation and the geomagnetic activity. No significant influence of the geomagnetic cutoff values is found. The comparison of average data for 1957-1958 and 1959-1960 gives evidence of world-wide amplitude effects. A few suggestions for the choice of data for daily-variation analysis are given. (auth)

34312 ON THE CORRELATION BETWEEN THE DAILY VARIATION OF THE NUCLEON COMPONENTS OF COSMIC RADIATION AND THE EARTH'S MAGNETIC DISTURBANCES. Jost, P. (Univ., Bern). Helv. Phys. Acta, 41: 487-92(July 1, 1968). (In German).

The analysis of the daily variation of the cosmic-ray nucleonic component, as originally developed by Dorman, is applied to the case of two superposed anisotropic components. These components are assumed to lie near the ecliptical plane in directions corresponding to 18.00 and 24.00 h local time. The results are compared with neutron monitor data of Climax, Deep River, Jungfraujoch, Uppsala, and Zugspitze from 1957 to 1960. No agreement is found, whereas previous experimental results of Debrunner and Houtermans appear to agree with the two-component-theory. (auth)

34313 STUDY OF HARD GAMMA RADIATION IN THE ATMOSPHERE. Chuykin, E. I.; Romanov, A. M.; Lenin, A. S. (Ioffe Inst. of Physics and Tech., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 659-62(1967).

Translated from Geomagn. Aeron., 7: 810-14(1967).

The results of a study of γ quanta in the atmosphere are reported. The measurements were made in 1966 at geomagnetic latitude 47°N and at depths in the atmosphere of up to 9 g cm^{-2}. The study of the spectrum and height dependence of the vertical intensity of γ quanta >100 MeV was continued with a gamma telescope. (auth)

34314 ALLOWANCE FOR THE BAROMETRIC EFFECT OF THE NEUTRON COMPONENT DURING COSMIC-RAY BURSTS. Kaminer, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 656-8(1967).

Translated from Geomagn. Aeron., 7: 806-9(1967).

A formula is derived for allowing for the barometric effect of the neutron component during cosmic-ray bursts. The formula takes into account the difference in the mean free paths for absorption of the galactic and solar components of the neutron flux and the difference in the average barometric pressures at cosmic-ray stations. (auth)

34315 VERTICAL INTENSITY OF HARD GAMMA RADIATION AT SEA LEVEL. Chuykin, E. I.; Romanov, A. M.; Lenin, A. S. (Ioffe Inst. of Physics and Tech., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 719-20(1967).

Translated from Geomagn. Aeron., 7: 886(1967).

Ground measurements were made of the vertical intensity of γ rays with an energy $E > 70$ MeV. Most of the measurements were made at a point with a geomagnetic latitude $\lambda_m = 57$ °N. The geometric parameters of the two telescopes were $\Gamma_1 = 2$ cm^2 ster and $\Gamma_2 = 4.8$ cm^2 ster. The averaged results of the measurements are summarized. (W.D.M.)

34316 MODULATION OF DIURNAL COSMIC-RAY VARIATION RECORDED ON EARTH. Dorman, L. I.; Fisher, S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 651-5(1967).

Translated from Geomagn. Aeron., 7: 799-805(1967).

The modulation of diurnal and semidiurnal cosmic-ray variations produced by the noncoincidence of the axis of rotation of the Earth with the perpendicular to the plane of the ecliptic is analyzed. Four spatial anisotropy distributions are investigated and the amplitudes of the resulting solar-diurnal and stellar-diurnal harmonics are estimated. The results obtained are compared with experimental data. (auth)

34317 COSMIC-RAY DISTRIBUTION AND THE ACCEPTANCE VECTORS OF DETECTORS. IV. Krimskii, G. F.; Altukhov, A. M.; Krivoshapkin, P. A.; Kuz'min, A. I.; Skripin, G. V.; Chirkov, N. P. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 647-50(1967).

Translated from Geomagn. Aeron., 7: 794-8(1967).

A matrix method of transforming the cosmic-ray distribution vector is described and illustrated. (auth)

34318 ^{26}Al AND ^{10}Be IN MARINE SEDIMENT. Tanaka, S.; Sakamoto, K.; Takagi, J.; Tsuchimoto, M. (Tokyo Univ.). Science, 160: 1348-9(June 21, 1968).

Activities of ^{26}Al and ^{10}Be in marine sediment were measured at 0.01 ± 0.13 and 4.4 ± 0.9 disintegrations per minute, per kilogram dry weight, respectively. Only an upper limit of 0.03 could be determined for the ratio of ^{26}Al to ^{10}Be in the sediment. The ratio is probably explained by production of cosmic rays in the atmosphere. (auth)

34319 DETECTION AND MEASUREMENT OF COSMIC-RAY ELECTRONS. Bland, C. J. (Univ., Milan. GIFCO, Milan); Boella, G.; Degli Antoni, G.; Dilworth, C.; Scarsi, L.; Sironi, G.; Agrinier, B.; Koechlin, Y.; Parlier, B.; Vasseur, J. Nuovo Cim., 55B: 451-75(June 11, 1968).

The flux and the east-west asymmetry of the primary cosmic-ray electrons were investigated at a geomagnetic cut-off rigidity of 5.36 GV, during the period November 1963–September 1965. Four successful balloon flights of a small multiplate spark chamber containing 5 radiation lengths of lead have been carried out. A value for the integral flux of primary electrons $F(\geq 5.4 \text{ GeV}) = (5.3 \pm 0.5) \text{ m}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$, and an east-west asymmetry coefficient for observations at 38° to the vertical $A = 2(F_W - F_E)/(F_W + F_E) = -(0.41 \pm 0.21)$ were obtained. It is shown that this asymmetry coefficient indicates that the major fraction of the primary electrons, in the energy region $4.6 \text{ GeV} \leq E \leq 6.5 \text{ GeV}$, is negative in charge. In this energy interval the differential flux of the negative excess is $(1.2 \pm 0.6) \cdot 10^{-3} \text{ m}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ MeV}^{-1}$, assuming the calculated values for the geomagnetic cut-off. (auth)

34320 ISOBAR PROCESS AND LANDAU PROCESS IN COSMIC-RAY JETS. Kazuno, M. (Dublin Inst. for Advanced Studies). Nuovo Cim., 56A: 1-14(July 1, 1968).

The properties and the production mechanism of very energetic secondary pions observed in cosmic-ray jets were investigated by comparing them with those expected in the isobar process and the Landau process. The production frequency of energetic secondary π^0 mesons in the experiment agrees with that expected in the isobar process. The energies carried by those energetic pions and their angular distribution could be explained by either of above processes. The charge ratios of such pions in the experiment are rather favorable to the isobar process. (auth)

Direct Energy Conversion

Refer also to abstracts 33591 and 35726.

34321 (AD-661455) STUDY OF THERMOELECTRIC AND THERMIONIC POWER CONVERSION. Final Report, February 1, 1966–January 31, 1967. Jasinski, R. J.; Wald, Fritz (Tyco Labs., Inc., Waltham, Mass.). Oct. 1967. Contract N00014-66-C-0147. 235p. CFSTI.

The state-of-the-art of thermoelectric and thermionic power conversion is discussed. The report is intended to bridge the gap between the producers and researchers active in the field and the potential users of the devices. Emphasis is placed on those problem areas inhibiting further exploitation of the fields, in particular, materials problems. The anticipated trends in research and development for the near future are defined. (auth) (USGRDR)

34322 (AD-661586) NONUNIFORM ELECTRICAL CONDUCTION IN MAGNETOHYDRODYNAMIC CHANNELS. Oliver, David A. (Stanford Univ., Calif. Inst. for Plasma Research). May 1967. Contracts AF49(638)-1695; NAS3-6261. 182p. (SU-IPR-163; AFOSR-67-2651). CFSTI.

Methods of describing steady electrical conduction in a partially ionized gas with Hall effect, strong applied or magnetically induced electric fields, and a nonuniform electrical conductivity are proposed. One of these methods is based on model conductivity distributions, and the other is based on a nonequilibrium conductivity and incorporates the electron energy and ionization equations. The occurrence of a nonequilibrium conductivity leads to the development of an ionization instability. It is shown that the steady equations with a nonequilibrium conductivity are of mixed elliptic–hyperbolic type and that the condition for the uniform ellipticity of these equations is identical to the condition for the prevention of the ionization instability. These methods are applied to flowing gases in two-dimensional linear MHD channels with segmented-electrode structures. Detailed numerical solutions for current and potential are obtained. In general, it is found that conductivity nonuniformities lead to a degradation of performance as reflected in increased internal impedance of the conducting gas and depressed Hall voltage. Theoretically obtained distributions of current on electrodes in contact with a nonuniformly conducting gas are found to be in accord with experimental measurements. (auth) (USGRDR)

34323 (AD-661771) STATUS AND PERSPECTIVES OF DEVELOPING MAGNETOHYDRODYNAMIC GENERATORS. Moskvitin, A. I. Translation of Voprosy Razvitiya Energetiki, n.p., 1964. 42p. (FTD-HT-66-378). CFSTI.

Work on MGD generators in world technology has sharply progressed in recent years. According to conduction generators with thermal equilibrium ionization, in the most theoretically and experimentally processed, powers of experimental samples were obtained up to 1350 kW. Probably, in the relatively close future, experimental stations of thermal power will be built of the order of 150 to 250 MW, although there are still many problems to be solved, mainly pertaining to materials. In this connection, reports are presented on further increase in electric conductivity, expansion of temperature boundaries, reduction of dimensions and increase in effectiveness on the basis of nonequilibrium ionization, pulsating flow of plasma and transition to electrodeless systems. (auth) (USGRDR)

34324 (AD-662636) RESEARCH DIRECTED TOWARD THE STUDY OF IONIC AND NEUTRAL SPECIES IN THERMAL PLASMAS. Final Report, August 1, 1964–August 31, 1967. Heil, H.; Scott, B. W.; Hollweg, J. V. (Hughes Research Labs., Malibu, Calif.). Sept. 1967. Contract AF19(628)-4297. 165p. (AFCRL-67-0500). CFSTI.

Two sets of experiments were designed to study the gas discharge in cesium plasma thermionic converters. The first experiments measured the energy spectra of charged particles extracted through a small hole in the anode of an operating energy converter. From these ion and electron spectra the temperatures were deduced and the emitter sheath height was measured. The second experiments were to investigate cross sections relevant to an understanding of the ionization processes present in the converter. The ionization and charge exchange cross sections were studied in detail. In addition to the various cross sections, the reflection of zero energy electrons at surfaces was investigated both by experiment and by computer experiment. Results and experimental techniques are described in detail. (auth) (USGRDR)

34325 (RT/FI-(68)7) ELECTRON TEMPERATURE DISTRIBUTION IN A PLASMA DIODE. Boffi, V.; Molinari, V.; Parks, D. E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 23p. Dep.

A detailed theoretical analysis was made of the electron temperature distribution in a fully ionized and electrically neutral plasma contained between two plane parallel electrodes of infinite extent. (M.O.W.)

34326 THERMODYNAMIC ANALYSIS OF A CLOSED CYCLE WITH MHD GENERATORS AND MHD COMPRESSORS. Yakimenko, V. L. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 306-14(Mar.-Apr. 1968). (In Russian).

The effect of the Joule loss in the channels of MHD generators and MHD compressors on the efficiency of the closed cycle was determined. It was assumed that the electroconductivity of the gas was maintained by means of a nonequilibrium ionization mechanism. The Faraday variant of the MHD channel was investigated. The gas current was considered one-dimensional and the Reynolds magnetic number as small. With increase of the gas current the Joule losses increased and the useful output and the k.p.d. of the cyle sharply decreased. The values at which the k.p.d. of the cycle is positive was determined. If Ar with Cs supplement is used as a working gas, the temperature raised to $T_1 \ll 2000°K$, and the magnetic field in the MHD channel $B = 40$ kG, then at gas pressure in the heater $p_1 \gtrsim 5$ atm, the generator output exceeds the energy consumption in the compressor. (tr-auth)

34327 CHARACTERISTICS OF MAGNETOGASDYNAMIC CONVERTER INSTALLATIONS OPERATING IN RANKINE CYCLE. Mokrushin, S. A.; Radchenko, R. V.; Stepanov, V. G.; Sheinkman, A. G. (Ural Polytechnic Inst., Sverdlovsk, USSR). Teplofiz. Vys. Temp., 6: 327-32(Mar.-Apr. 1968). (In Russian).

The results of the comparative thermodynamic analysis of MHD installations, operating in Brayton and Rankine cycles are reported. It is shown that with realization of nonequilibrium ionization of the Rankine cycle it is possible to produce conversion at high values of the M number in the channel. An analysis is made of the operating materials suitable for work in Rankine cycle. (tr-auth)

34328 INVESTIGATION OF THERMIONIC EMISSION AT LOW INTENSITY WITH A GEIGER COUNTER. Sastri, R. C.; Chatterjee, S. D. (Jadavpur Univ., Calcutta). Indian J. Phys., 41: 793-802(Nov. 1967).

An attempt has been made to investigate thermionic emission at low intensities by counting the individual electrons with a Geiger counter. In the first case, a Geiger counter with its axial anode wire is heated to serve as an electron emitter. Subsequently, a heated offset wire parallel to the axial wire anode is operated as an electron emitter. In either case, Richardson's thermionic emission equation is verified while the lowest figure to the thermionic current density measured is 3 electrons/cm^2 sec. (auth)

34329 MAGNETOHYDRODYNAMIC GENERATORS WITH SEMICONDUCTING ELECTRODES. Croitoru, Z. Rev. Gen. Elec., 74: 873-80(Nov. 1965). (In French).

Analysis of optimum conditions for functioning of a MHD generator shows that when the Hall effect is important, a component of the electric field parallel to the flux (and thus to the electrodes) exists. This component cannot exist for conducting, continuous electrodes. Segmented electrodes could solve the problem but create perturbations near the segments and their insulators. Semiconducting electrodes offer a better solution since they permit uniform conditions in the generator. Simple solutions are proposed for the suppression of losses at extremities of the generator. Different configurations (independent charges, electrodes in series, Hall generator) are discussed for semiconducting electrode generators. The solution does not avoid the necessity of segmentation, nor of supplementary losses, but these effects are not placed in contact with the gas; thus the gas is uniform. (BBB)

34330 TWO-DIMENSIONAL ANALYSIS OF THE MHD GENERATOR WITH SERIES-CONNECTED ELECTRODES. **Celinski, Z. (Instytut Badan Jadrowych, Warsaw). Arch. Elektrotech. (Warsaw), 17: 47-68(1968). (In Polish).**

Electrical parameters were studied in an MHD generator, with electrodes connected by series, by numerical analysis for a wide range of electrode dimensions and values of the Hall parameter generally used. A method for determination of the generator terminal values, based upon the results of the numerical calculations, was devised. Deviations of the terminal values in finite-length electrode generators from those in the ideal case of infinitely segmented electrodes were determined. The correction factors λ were calculated and presented in the form of curves as functions of geometric dimensions (s/h) electrode size (c/s), Hall parameter (β), and electric connection parameter (α). Constant gas dynamic parameters and constant generator cross section were assumed. The optimum electrode size (for maximum electrical power) $(c/s)_{opt}$ was determined as a function of s/h, β, and α. The optimum electrode connection (for maximum electric power) α_{opt} was also determined as a function of s/h, β, and c/s. The magnitude of α_{opt} was higher than α^{I}_{opt} determined from 1-dimensional analysis ($\alpha^{I}_{opt} = 1/\beta$) and is $\alpha_{opt} \cong (1/\beta) + (s/h)$ for $c/s \cong 0.5$. Comparison of various systems for electrical connections between the electrodes indicated that the most advantageous system was that of connecting the electrodes in a series with $\alpha = \alpha_{opt}$ and $c/s = c/s_{opt}$. This gave the maximum electrical power, the minimum possible number of separate load circuits, and the most advantageous parameters of electrical power, high voltage, and low current. The influence of finite-length electrodes on electrical parameters in an MHD generator is generally large. The choice of electrode width, especially for large β is not critical. By introduction of a correction factor λ, it was possible to estimate the deviation of all electric parameters from their theoretical values obtained in the one-dimensional analysis. (BBB)

34331 ANALYSIS OF A DIRECT CONVERSION PROCESS WITH A LIQUID METAL WORKING FLUID. **Radebold, Reinhart. VDI (Ver. Deut. Ing.) Z., 110: 552(May 1968). (In German).**

Adaption of a thermodynamic drive to a liquid metal MHD converter can be accomplished by thermodynamic transformation and is then based on the strong interaction between the gas and the liquid droplet in a fog-like two-phase flow. The energy of the gaseous phase serves to accelerate both the gaseous and the liquid phase. By stage-wise loading the flow with dispersed liquid it is possible to adjust the end velocity of the two-phase flow in a wide range. (auth)

34332 STEADY ONE-DIMENSIONAL FLOW OF A CONDUCTING MEDIUM IN VARIOUS TYPES OF MHD GENERATORS. Pelz, P. Acta Tech. CSAV, 11: 527-43(1966).

MHD generators can be classified according to how the electrodes are interconnected. Here, four types are identified: viz., Faraday, Hall, Faraday with oblique connections, and Hall with oblique shorting straps. Calculations are carried out for generators having constant cross section and uniform magnetic flux density (neglecting induced fields), and for one-dimensional flow of a fluid of constant (tensor) electrical conductivity, negligible viscosity (except that constant wall friction and heat transfer from the channel walls are included), and obeying the perfect-gas equation of state. The results consist of expressions for state variables, velocity, current-density components, electric field, and specific power output, all as functions of the distance along the channel. Formulas for terminal voltage also are obtained. The results involve four constants whose values determine which of the four types of generator is being considered. A simple table lists the appropriate values (mostly zeros and ones) to be selected for each type, and thus, the author's results include all four. (TSS)

34333 IDENTIFICATION OF THE IONIC SPECIES IN A CESIUM PLASMA DIODE. **Agnew, L.; Reichelt, W. H. (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 39: 3149-55(June 1968).**

The identification of the dominant ionic species in the cesium plasma diode was established experimentally as the atomic ion, Cs^+, instead of the molecular ion, Cs_2^+. Values of the atomic ion density, N_i, have been determined spectrographically by measurements of the radiative recombination spectrum leading to the 6P state. Electron densities, N_e, were measured independently by the Stark broadening of selected cesium lines. Within experimental uncertainty for a broad range of diode operating conditions, $N_i = N_e$. Thus, not only are Cs^+ ions directly observed, but any important concentrations of Cs_2^+ would violate plasma neutrality. The experimental results are consistent with the existence of local thermodynamic equilibrium. (auth)

34334 A STUDY OF THE POSSIBILITIES OF SELF-EXCITATION OF AN MHD INDUCTION GENERATOR WITH A RADIAL MAGNETIC FIELD AT A CONTINUOUS PLASMA THROUGHFLOW. **Lego, Jindrich. Elektrotech. Obz., 57: No. 2, 88-92(Feb. 22, 1968). (In Czech).**

The possibility of designing an MHD induction generator with self-excitation and a radial magnetic field at a continuous plasma throughflow is discussed. The conditions of operation of such a generator and its output under various kinds of excitation are reviewed. (In Czech) (JPRS)

34335 STUDY OF EXTREMITY AND INDUCED MAGNETIC FIELD EFFECTS IN AN MHD GENERATOR. **Dragos, L. (Univ. of Bucharest). Int. J. Eng. Sci., 5: 919-38(Dec. 1967). (In French).**

The problem treated is that of the expansion of an electrically conducting fluid to infinity in a jet tube of constant rectangular section, with two of the electrodes applied in the region $x \geq 0$ of the horizontal and vertical isolating boundaries, where the x axis is the axis of the jet tube. Flow occurs in the presence of an external magnetic field applied only in the electrode region. The mathematical problem, presented in terms of distributions, is set up in terms of two parameters R_M and $\lambda = R_M R_H$. Functions for current, potential, and magnetic field are approximated by a power series in λ derived by an iteration process using three Green functions. Other theories have neglected the presence of the magnetic field induced by plasma flow; the results obtained here allow a calculation of its strength regardless of the importance of the deviation caused by the previous assumption. (BBB)

Fluid Physics

Refer also to abstracts 33815, 34331, 34332, and 34686.

34336 (AD-664914) MAGNETOHYDRODYNAMIC FLOW NEAR A STAGNATION POINT. **Stubbe, Elie J. (Toronto Univ. (Ontario). Inst. for Aerospace Studies). Jan. 1968. Contract AFOSR-68-0063. 74p. (UTIAS-TN-122). CFSTI.**

Some interaction effects of a plasma flowing around a blunt body in the presence of a strong magnetic field were investigated. A one-inch circular shock tube was used to provide the plasma during a testing time of approximately 30 μsec. The required magnetic field strength was produced by discharging a 0.238-F electrolytic capacitor bank through a coil. The coil axis was parallel with the axis of the shock tube, generating a purely axial magnetic field of 60,000 G, over a period of 4 msec, at the stagnation point. The blunt nosed model was a ⅜-inch-dia hemisphere–cylindrical body made of lucite plastic and was mounted at the center of the coil. Interaction effects of the plasma with the applied magnetic field were observed in the form of an appreciable change in standoff distance of the bow wave. The behavior of the induced currents and the induced flux density were examined by using three pickup coils placed around the shock tube. This arrangement also made it possible to gain some more information about the available testing time and the values of the effective electrical conductivity of the argon plasma. Calculations covering a shock Mach number range from 9 to 19 were presented and a simple theory was worked out for the particular magnetic field configuration. The validity and the significance of the calculations and experiments are discussed together with some proposals for further work. (auth) (USGRDR)

34337 (AD-665870) MHD ROUND PIPE FLOW EXPERIMENTS. **Final Report, January 1965–November 1967. Loeffler, Albert L. Jr.; Maciulatis, Algirdas; Hoff, Marc (Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.). Dec. 1967. Contract AF33(615)-5269. 131p. (ARL-67-0236). CFSTI.**

Experiments were performed with liquid mercury flowing through electrically insulated circular channels in the presence of a uniform transverse magnetic field. The circular channels were equipped with static pressure taps along their length so that it was possible to determine the axial pressure gradient in the fully developed portion of flow. The three channels had inside diameters of

6.144, 0.800, and 0.505 cm. The maximum magnetic field was 1.9 webers/sq. m and the length of the magnetic field region was about 1.52 m. Maximum Reynolds numbers of 2,800,000 and maximum Hartmann numbers of 3012 were obtained. Friction factors are presented for the laminar and turbulent flow regimes. In addition to pressure distributions, velocity profiles were measured by means of pitot tubes in the largest test section for magnetic field of zero, 1.0, and 1.9 webers/sq. m, corresponding to Hartmann numbers of 0, 1597 or 3033, respectively, along two different traverses: a radius perpendicular to the magnetic field and a radius parallel to the magnetic field. Parallel to the magnetic field, the velocity profiles were almost completely flat for the fields of 1.0 and 1.9 webers/sq. m. The profiles perpendicular to the field, however, were fairly steep. The theoretical analyses predicted similar core velocity profiles for both laminar and turbulent flow. (auth) (USGRDR)

34338 (AD-666605) SOME DIFFICULTIES IN THE THEORY OF MAGNETOGASDYNAMIC FLOWS INVOLVING UPSTREAM INFLUENCE EFFECTS. Swan, G. W. (Wisconsin Univ., Madison. Mathematics Research Center). Dec. 1967. Contract DA-31-124-ARO(D)-462. 11p. (MRC-TSR-765). CFSTI.

In the mathematical analysis of certain types of magnetogasdynamic flow problems in which boundaries are present it is necessary to take account of the solution of the Maxwell equations in the boundary regions. Some authors have neglected to consider this solution, and some of the formulations which are defective in this respect are commented on. (auth) (USGRDR)

34339 EXPERIMENTAL STUDY OF ENTRAINMENT MOTIONS OF A LIQUID BY PLANE WALLS IN THE PRESENCE OF A MAGNETIC INDUCTION FIELD. Amy, Josette; Bardon, Jacques; Poirier, Yves (Faculte des Sciences de Marseille-Luminy, Marseille). Compt. Rend., Ser. A and B, 266: 641-3 (Mar. 18, 1968). (In French).

Experimental results are reported on two sorts of entrainment motions, by sliding of the plane walls of a viscous and electroconductive liquid in the presence of a magnetic induction normal to the motions. Curves illustrate the results obtained theoretically and experimentally. (tr-auth)

34340 PROBLEM OF RELATIVISTIC MAGNETOHYDRODYNAMICS. Arzelies, Henri (Faculte des Sciences, Rabat, Morocco). Compt. Rend., Ser. A and B, 266: 668-70(Mar. 25, 1968). (In French).

The new equations proposed previously (Nuovo Cimento, 50: 287(1967); Compt. rend., 264A: 463(1967)) for relativistic fluid mechanics are applied to a propagation problem in magnetohydrodynamics. (tr-auth)

34341 EXISTENCE AND UNIQUENESS OF SOME UNSTEADY FLOWS SATISFYING A CIRCULATION PROPERTY. Sanchez-Palencia, Enrique (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 683-5(Mar. 25, 1968). (In French).

The two-dimensional flow of an incompressible, viscous, and electroconducting fluid around a body in translation motion starting from rest is studied. The existence and uniqueness of a weak solution of the problem are shown. The circulation rates and the magnetic field along a circumference approach zero when the radius approaches infinity. (tr-auth)

34342 STEADY AXI-SYMMETRIC MAGNETOHYDRODYNAMIC FLOW. Gundersen, Roy M. (Univ. of Wisconsin-Milwaukee, Milwaukee). Z. Angew. Math. Phys., 19: 316-25(Mar. 25, 1968).

A study was made of the equations describing steady axi-symmetric flow. In each of the three possible cases in which the induction vector has two zero components, it is possible to find integrals of the basic equations so that a reduced number of differential equations would adequately describe the flow. A linearized theory for initially uniform flows is developed in terms of a perturbation stream function which satisfies a linear second-order partial differential equation affinely equivalent to Poisson's equation or a cylindrical wave equation. (M.H.R.)

34343 DRAG AND HEAT TRANSFER IN COUNTERCURRENT FLOWS OF ELECTROCONDUCTING LIQUIDS IN THE PRESENCE OF MAGNETIC FIELDS. Novikov, I. I. Izmer. Tekh., No. 5, 41-5(May 1968). (In Russian).

The resistance to motion and heat transfer in axially symmetric countercurrent flows of electroconducting liquids in the presence of an external axial magnetic field was examined. Similar flows take place in magnetohydrodynamic generators and some types of magnetic flowmeters. In the approximation of the boundary layer, the dependences for the coefficients drag and heat transfer were derived for laminar and turbulent flow regimes. (tr-auth)

34344 THE MONGE-AMPERE EQUATION IN MAGNETOHYDRODYNAMICS. Gundersen, Roy M. (Univ. of Wisconsin, Madison). J. Math. Mech., 17: 491-506(Dec. 1967).

Martin has shown that the solution of problems in two-dimensional steady flow may be reduced to finding solutions of a Monge-Ampere partial differential equation. The method is based on forming proper combinations of the continuity equation and the two momentum equations. The resultant equations may then be interpreted as integrability conditions for 3 functions which, satisfy a Pfaffian system, along with flow quantities. This latter system may be solved analogously to integrating a Monge-Ampere equation. The solution leads to a parametric representation of the flow. Martin's investigation may be extended to some 2-dimensional steady magnetohydrodynamic flows of a perfectly conducting fluid. In particular, flows subjected to magnetic fields can be studied if at most one component of the magnetic induction does not vanish. For this special class of flows, the equations simplify greatly, and the three possible cases may be studied virtually simultaneously. Structurally, they lead to the same differential equation, the only difference being in the definition of one of the independent variables, P, the sum of the fluid and magnetic pressures. With the choice of the stream function and the total pressure P as independent variables, these special magnetic flows are governed by equations structurally identical to the equations considered by Martin. His analysis may therefore be extended directly with minor modifications. (BBB)

34345 POINT ELECTRIC DISCHARGE IN A LIQUID. Naugol'nykh, K. A.; Roi, N. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 137-41 (July-Aug. 1967). (In Russian).

The release of energy in a spark discharge causes the formation of a plasma at a high temperature and pressure with rapid expansion accompanied by emission of a compression wave and subsequent formation of a pulsating gas bubble. The emitted energy E is expended in increasing the internal energy of the plasma W and in doing work A to overcome the resistance of the surrounding medium. The hydrodynamic and electrical characteristics of the discharge are related by an energy balance equation in the spark. The expansion of the spherical spark bubble, the gas pressure in the spark bubble, the parameters of the compression wave, and other hydrodynamic quantities are derived from a solution of the energy-balance equation. The hydrodynamic characteristics of the gas bubble can be calculated from the known values of the capacitance C, inductance L, and potential U of an electrical discharge. The first pulsation period of a gas bubble close to a solid reflector at a depth of 0.5 in. from the surface of the water was found to be 12.9 msec experimentally, while the calculated value was 16.6 msec. The calculated bubble energy was 47%, while the experimental value was found to be 22% of the imparted energy. The calculated electrical-acoustic efficiency was 12%, while the experimental value was 14%. (TTT)

34346 EXPERIMENTS ON TRANSVERSE IONIZING MHD SHOCK WAVES. Stebbins, Charles Fleming. Boulder, Colo., Univ. of Colorado, 1967. 99p.

Thesis.

The jump conditions across a transverse ionizing MHD shock wave, where the magnetic field is in the plane of the shock, are examined. The simple conservation laws, in conjunction with Maxwell's laws and the equation of state, yield three jump equations in four unknowns. The ionizing wave, then, requires an additional descriptive relationship for a unique solution to the jump equations to exist. Several theories that attempt to supply this missing relationship are examined including the theory of Lyubimov and Kulikovskii and later, Chu where the internal structure of the shock itself supplies the missing relationship. In particular, Lyubimov and Kulikovskii show, for appropriate ratios of the thermal diffusivity to the magnetic diffusivity, that for low-speed shock waves the magnetic field compression across the shock is unity and the jump equations reduce to the ordinary Rankine-Hugoniot relations. For high-speed shock waves, the magnetic field compression, B_2/B_1, is equal to the gas compression across the wave, ρ_2/ρ_1, and the jump equations become exactly the magnetohydrodynamic jump relations. Furthermore, intermediate speed shocks experience a magnetic field compression between 1 and ρ_2/ρ_1. An experiment was performed where $\bar{E}$ behind the shock, the shock and piston velocities, and the magnetic field compression across the shock were measured over a wide range of initial conditions and shock velocities. The jump relations were written with B_2/B_1 as parameter and programmed into a digital computer. The program was written for equilibrium hydrogen with real gas effects included in the equation of state. The program provided easy access to a unique solution of the jump equations for B_2/B_1 equal to 1, ρ_2/ρ_1, and the value measured in the experiment. The experiment tends to confirm the Lyubimov-Kulikovskii-Chu theory. Ordinary shock waves were observed at low speeds and near-MHD shocks were observed at high speeds. Further, the relation, $\vec{E} = \vec{u} \times \vec{B}$, was verified for the hot gas behind the shock for low-speed shock waves, and was verified to within experimental accuracy for the intermediate class of shock waves. (Disser. Abstr.)

34347 THEORETICAL AND EXPERIMENTAL STUDY ON THE HYDRAULIC MODEL OF RAYLEIGH-TAYLOR INSTABILITIES IN MAGNETOHYDRODYNAMICS. Nguyen Duc, Xuong (Institut Francais du Petrole, Ruel-Malmaison, France). Compt. Rend., Ser. A and B, 266: 738-40(Apr. 1, 1968). (In French).

The Rayleigh–Taylor instabilities were studied in a model containing two nonmiscible liquids exposed to Lorentz forces. The experimental results, which are in good agreement with theory, showed that the instabilities are produced only in the plane parallel to the magnetic field and that the characteristic growth time of the instabilities is inversely proportional to the square root of the perturbing forces. (tr-auth)

34348 APPARATUS FOR THE STUDY OF THE ACTION OF TRANSVERSE MAGNETIC FIELDS ON THE SHOCK WAVES IN MAGNETODYNAMIC TUBES. Chartier, Charles; Borzeix, Jacques (Faculte des Sciences, Poitiers, France). Compt. Rend., Ser. A and B, 266: 733-4(Apr. 1, 1968). (In French).

A description is given of the apparatus for the study of the effect of transverse magnetic fields on magnetodynamic shock waves obtained by the condenser discharge of a capacitive bank, with the aid of a thyratron chain trigger fed by normalized and delayed synchronization pulses. (tr-auth)

34349 DIFFUSION OF A CHARGED FLUID. Dixon, R. C. Int. J. Eng. Sci., 5: 265-87(Mar. 1967).

The theory of continuous media is employed in developing a dynamical theory to explain the interaction of electromagnetic fields with a two-fluid mixture. The fluids are considered charged and electrically conducting, but are not polarized or magnetized. Relativistic and thermal effects are not included. The field equations are postulated in integral form for the entire mixture instead of each fluid separately. This gives fewer conceptual difficulties, especially when electromagnetic variables are present. A brief derivation of the appropriate boundary conditions for a fixed surface of discontinuity and the conservation of energy equation is then given. The general constitutive equations are constructed from a linear series of the various objective velocity variables. The effective electric field is assumed to give each fluid a preferred direction for fluid flow and charge conduction. By the proper reduction of these equations, a mathematical model is obtained which gives a modification of Fick's law of diffusion to account for the effect of an applied electric field. Finally, numerical solutions are presented for the fluid diffusion between two parallel plates maintained at a constant potential difference. The effect of a linear semiconductor slab on one plate with an initial surface charge also is included. (auth)

34350 STABILITY OF A HARTMANN BOUNDARY LAYER UNDER THE INFLUENCE OF A PARALLEL MAGNETIC FIELD. Abas, S. (University Coll. of North Wales, Bangor). J. Fluid Mech., 32: 721-35(June 1, 1968).

Stability to infinitesimal disturbances—when a parallel magnetic field is imposed—is investigated for the flow in the boundary layer set up by two-dimensional motion between parallel planes of a viscous, incompressible, electrically conducting fluid under the influence of a transverse magnetic field. The flow is assumed to take place at low magnetic Reynolds number. The usual asymptotic methods are employed for the solution but, apart from the Tollmien-type power series solution, an exact solution of the inviscid equation is obtained in terms of the hypergeometric function and its analytic continuation. Curves of neutral stability for two-dimensional disturbances are calculated, and the results for critical Reynolds number are modified to take into account three-dimensional disturbances. The parallel magnetic field is found to have a strong stabilizing influence. (auth) (UK)

Geophysics

Refer also to abstract 34135.

34351 (AD-660555) EXPERIMENTAL STUDIES OF THE ARCTIC D-REGION. Landmark, Bjoern (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Jan. 30, 1967. Contract AF61(052)-599. 26p. (NDRE-E-100; AFCRL-67-0282). CFSTI.

The first part of this report deals with results from propagation experiments for measurements of the density and collision frequency of the free electrons during conditions of auroral absorption. The results obtained during a flight on June 26, 1966, are discussed in some detail. Results from rf impedance probe measurements of electron density and temperature are then discussed, and finally measurements of primary electrons by a Geiger–Muller tube experiment are given. (auth) (USGRDR)

34352 (AD-660911) RECENT RESULTS OF INNER ZONE PARTICLE FLUXES. Freden, S. C.; Blake, J. B.; Paulikas, G. A. (Aerospace Corp., El Segundo, Calif.). Sept. 1967. Contract F04695-67-C-0158. 27p. (TR-0158(3260-20)-1; SAMSO-TR-67-46). CFSTI.

Some recent data, calculations, interpretations of inner zone proton fluxes and spectra and their time variations are presented. Sources and losses are discussed. Recent measurements of inner zone electron fluxes and spectra are also given and comparisons are made with pre-Starfish and earlier post-Starfish data. Decay lifetimes for the Starfish electrons are shown. (auth) (USGRDR)

34353 (AD-661285) THE FLUID TRANSPIRATION ARC AS A RADIATION SOURCE FOR SOLAR SIMULATION. Semi-annual Progress Report, January 1–June 30, 1967. Sheer, C.; Korman, S. (Columbia Univ., New York. Electronics Research Labs.). Contract AF49(638)-1395. 46p. (AFOSR-67-2363). CFSTI.

The background of the fluid transpiration arc, including a discussion of both the cylindrical offset and conical coaxial geometries, is presented. A description of certain features that offer possibilities of improved source performance is also included. In particular, the high ionization of the FTA anode column plus the effectiveness of high velocity cathode injection to enhance brightness and inhibit cathode ablation has led to a new concept for a plasma source. This involves a colinear opposing-flow geometry to generate a large stagnant zone in the arc region of maximum excitation. A preliminary successful experiment on this configuration of 1-atm pressure is described. Also described are design and procurement of the first source of this type designed to operate at high pressures, including pressure vessel and recirculation system, as well as a complete system for radiometric analysis and measurements. (auth) (USGRDR)

34354 (AD-661562) A ROCKET MEASUREMENT OF LOW-ENERGY PROTONS. Environmental Research Papers No. 271. Kuck, George A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Aug. 1967. 13p. (AFCRL-67-0461). CFSTI.

The proton energy spectra from L = 2 to L = 3 were measured by a two-detector solid-state telescope carried by a rocket launched on March 30, 1965. The spectra were found to be well fitted by single exponentials of the form exp $(-E/E_0)$ for the two energy regions 0.2 to 1.5 MeV and 1.5 to 4.0 MeV. The energy parameter was found to be 0.4 to 1.2. The spectra were L dependent and in qualitative agreement with the inward radial diffusion theory. (auth) (USGRDR)

34355 (AD-661962) SOME CONSEQUENCES OF HYDROMAGNETIC TURBULENCE THEORY ON PARTICLES AND FIELDS PHENOMENA IN THE MAGNETOSPHERE. Chiu, Y. T. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 32p. (TR-0158(3260-20)-3; SAMSO-TR-67-73). CFSTI.

Model-independent consequences of the hypothesis that portions of the magnetosphere behind the bow shock are in a state of continual homogeneous turbulence are discussed. It is shown that such a hypothesis leads to a law governing the power spectra of magnetosheath and magnetosphere main-phase fluctuations, and this is in agreement with experiment. The long life of main-phase fluctuations is shown to follow from a theorem on the permanence of the largest eddies. Consideration is given to the theory that islands of energetic electron fluxes may be caused by electron acceleration by low-frequency, small-amplitude magnetosonic waves in a turbulent environment. Finally, the dominance of 30 to 40 minute fluctuations in the magnetosheath, geomagnetic storm main phase, the shock front, and the magnetophase emphasizes the importance of experimental cross-correlation study of particles and fields phenomena. (auth) (USGRDR)

34356 (AD-663111) FINAL REPORT ON GEMINI EXPERIMENT D-14 UHF-VHF POLARIZATION MEASUREMENTS. Ellis, R. E.; Goodman, J. M.; Sievers, W. (Naval Research Lab., Washington, D. C.). Oct. 20, 1967. 44p. (NRL-6591). CFSTI.

A vhf–uhf Faraday rotation experiment (D-14) was conducted in conjunction with six Gemini IX spacecraft transits over Kauai, Hawaii, and Antigua, British West Indies, on June 4, 1966. The rotational ambiguity at vhf was resolved by inspecting the received uhf polarization. The electron content and its inhomogeneities below the spacecraft were determined. By comparing the results of the data analysis corresponding to four closely spaced transits of Gemini IX over Hawaii, a measure of the prenoon electron-content variation was obtained. Assuming a Chapman distribution and equilibrium conditions, the lower ionospheric temperature was estimated to be approximately 1000 at midday. It was found that the smaller ionospheric inhomogeneities (approximately 10 to 30 km) occur in greater numbers than would be anticipated strictly on the basis of their size and sample-time considerations. The irregularity excursion delta C is found to be roughly an increasing function of irregularity scale delta L, with the percentage excursion Sub delta sub c increasing between 1% and 5% per 100 km. (auth) (USGRDR)

34357 (AD-663234) ATS-1 OMNIDIRECTIONAL SPECTROMETER. Quarterly Report No. 3, May 15–August 15, 1967. Paulikas, G. A.; Blake, J. B.; Freden, S. C.; Imamoto, S. S. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 31p. (TR-0158(3260-20)-4; SAMSO-TR-67-100). CFSTI.

Continuing analysis of electron data from the ATS-1 omnidirectional spectrometer shows (a) an electron flux vs time structure that exhibits periodicity probably associated with the interplanetary field sector structure, and (b) that magnetometer data fail to organize electron flux data; i.e., the electron flux variations are governed by temporal effects. Proton fluxes, some associated with flares, have been detected a surprisingly large fraction of the time. Further details of the proton events in January and February 1967 are presented. (auth) (USGRDR)

34358 (AD-663443) STATISTICAL INVESTIGATION OF IONOSPHERIC DRIFT. Final Scientific Report, April 1, 1963–March 31, 1967. Harnischmacher, E.; Rawer, K. (Ionosphaeren-Institut, Breisach (West Germany)). May 31, 1967. Contract AF 61(052)-672. 219p. (IIB-20; AFCRL-67-0503). CFSTI.

Drift data obtained with the three antennas fading method were analyzed with a simple "digitized" method using 12 steps for direction and 14 for the speed value. The reduction method was applied to observations at (A) Breisach, 1958/64, (B) Puerto Rico, 1954/60, (C) Eglin AFB, fall 1962. (A) concerns observations with 6 antennas i.e., in four triangles. By comparison it is stated that in spite of the rather large dispersion obtained with individual fades, the usual method using medians of about 10 fades gives rather satisfactory results. The angular error has median dispersion of ±18°, standard deviation of ±27°. A seasonal influence exists, it is rather small for the directional error but more important for the distribution of speeds. This influence is studied with differential statistical methods, and analyzed in terms of yearly and halfyearly variations. To (B) a complete set of monthly drift statistics is presented for the whole period. To (C) is shown similar statistics for three months, and individual data obtained from the artificial ion cloud of four "Firefly" release experiments. (auth) (USGRDR)

34359 (AD-663663) VHF REFRACTION AND SCATTERING BY VISIBLE AURORAL FORMS. Fremouw, E. J.; Lansinger, J. M. (Boeing Scientific Research Labs., Seattle, Wash. Geoastrophysics Lab.). Sept. 1967. Contract NAS5-3940. 21p. (D-1-82-0654). CFSTI.

Two relatively new techniques, one analytical and one observational, have been applied to the problem of differential phase shifting of radio waves by the aurora. The radio measurements used were interferometer observations of Cassiopeia A. The analytical technique consists of computing the Kirchhoff–Fresnel diffraction integral for models of wavefront perturbation produced in the ionosphere, the results being compared in detail with interferometer records of isolated refraction events. All-sky-camera and photometer records show many of these events to be directly related to passage of auroral forms through the radio line of sight. Random-scatter events were analyzed stochastically and compared in detail with the aurora in and near the line of sight. For this comparison, a high-sensitivity television camera was mounted on one of the tracking antennas, providing movies of the aurora with a time resolution of 100 milliseconds and comprising the new observational technique. (auth) (USGRDR)

34360 (AD-663711) LOWER D-REGION ROCKET EXPERIMENTS USING LOW FREQUENCY RADIO WAVE ABSORPTION. Middendorf, E. R. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Sept. 15, 1967. Contract F19628-67-C-0301. 52p. (AFCRL-67-0560). CFSTI.

A theoretical investigation was made of a possible method for determining electron densities and collision frequencies in the ionospheric D region. This involved the simultaneous measurement of the amplitudes of two radio waves of different frequencies, as a function of height, propagated from the ground to a rocket. It is hypothesized that the two frequencies can be used to recover, at each height of interest, the two unknown quantities, electron density and collision frequency. It is shown, however, that for any two propagation frequencies below the gyro frequency this method fails. It is shown also that these results are consistent with those that might be obtained using the WKB approximations based on the roots of the Booker quartic. An error analysis of the single-frequency method for determining electron densities assuming a single collision frequency model is also presented. (auth) (USGRDR)

34361 (AD-663751) MAGNETOSPHERIC TAIL STUDIES. 1. ANALYSIS OF HOURLY AVERAGED IMP-C DATA IN THE MAGNETOSPHERIC TAIL. 2. UNCOUPLING OF PARALLEL AND PERPENDICULAR PARTICLE MOTION IN A NEUTRAL SHEET. Report No. 306. Speiser, T. W. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Sept. 10, 1967. Contract AF 19(628)-4014. 22p. (AFCRL-67-0551). CFSTI.

34362 (AD-664034) NUCLEAR EXPLOSIONS IN AN IONOSPHERE WITH FINITE ELECTRON CONDUCTIVITY IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. Cap, Ferdinand; Rimer, Norton (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Nov. 5, 1967. Contract F61052-67-C-0014. 36p. (AFOSR-68-0148). CFSTI.

The problem of a nuclear explosion in the ionosphere approximated by an expanding spherical bubble was investigated. Based on the assumption of finite electric conductivity, there are two regions of interest, the plasma and the expanding bubble. Finite electric conductivity changes the system of equations from a purely hyperbolic to a mixed system. For this two-dimensional unsteady flow problem, the method of characteristics is far more difficult, since the characteristics are surfaces instead of curves. A numerical method involving a three-dimensional grid was developed. (auth) (USGRDR)

34363 (CONF-660950-(Pt.1)) PROGRESS IN RADIO SCIENCE, 1963–1966. PART I. COMMISSION I: RADIO MEASUREMENTS AND STANDARDS. COMMISSION II: RADIO AND THE TROPOSPHERE. COMMISSION III: IONOSPHERE. COMMISSION IV: MAGNETOSPHERE. COMMISSION IVa: NOISE OF TERRESTRIAL ORIGIN. Proceedings During XVth General Assembly of URSI, Munich, September 5–15, 1966. (International Scientific Radio Union, Brussels (Belgium)). 1186p.

The purpose of the Assembly is to review the progress and developments made in the many fields of radio science over the preceding three-year period and to lay the foundations of a program of research for the next triennium. Papers from the sessions on radio measurements and standards, radio and the troposphere, ionosphere, magnetosphere, and noise of terrestrial origin are presented. (W.D.M.)

34364 (CONF-660950-(Pt.2)) PROGRESS IN RADIO SCIENCE, 1963–1966. PART II. COMMISSION V: RADIO ASTRONOMY. COMMISSION VI: RADIO WAVES AND CIRCUITS. COMMISSION VII: RADIO ELECTRONICS. Proceedings During XVth General Assembly of URSI, Munich, September 5–15, 1966. (International Scientific Radio Union, Brussels (Belgium)). 1205p.

34365 (D-1-82-0691) MAGNETOSPHERIC PARAMETERS DETERMINED FROM STRUCTURED MICROPULSATIONS. Kenney, J. F.; Knaflich, H. B.; Liemohn, H. B. (Boeing Scientific Research Labs., Seattle, Wash. Geoastrophysics Lab.). Mar. 1968. 54p.

The structured elements in Pc1 and Pi1 events display characteristics of multihop and halfhop ulf whistlers, respectively. Analysis of these events which is carried out for different magnetic field and plasma distribution models yields useful information about the source and propagation of these micropulsations as well as information about the magnetospheric plasma distribution. The Pc1 propagation zone is centered about 75° geomagnetic latitude on the sunlit hemisphere, and about 65° on the dark hemisphere. Equatorial plasma densities are in general agreement with those determined from vlf whistler analysis and satellite observations. Evidence for spikes and steep gradients in the plasma density is presented. The region for propagation of structured Pi1 elements is located between 7 and 13 R_E at solar magnetospheric longitudes of approximately 135°. The difference between the structured Pc1 and Pi1 elements is discussed in terms of hypothetical sources and of the magnetospheric wave amplification by trapped particles in the ion-cyclotron resonance interaction. (auth)

34366 MEASUREMENT OF TEMPERATURES, ELECTRON DENSITY, AND IONIC COMPOSITION OF THE IONOSPHERE BY THOMSON SCATTERING. STUDY OF THERMODYNAMIC INSTABILITY OF THE DIURNAL IONOSPHERE. Petit, M. Ann. Geophys., 24: 1-38(Jan.-Mar. 1968). (In French).

The mechanism by which the electron temperature goes widely beyond that of neutral particles in a large part of the diurnal ionosphere was studied by Thomson scattering. A historical account and the theory of the Thomson scatter are given and the respective advantages of the two main experimental techniques used, namely the monostatic method and the bistatic method are pointed out. The rough result of the observations is the power spectrum of an electromagnetic wave and the method through which the fundamental physical parameters which it depends is deduced from this spectrum. Among these, the electronic density plays a particular part, inasmuch as it practically only occurs as a factor of proportionality without influencing the spectrum shape. Its determination is therefore directly connected to the problem of the received power level which sets the relation signal/noise, i.e., the accuracy of the results. This matter is studied. The method used to solve the difficulty raised during the measurements achieved in the transition region of the molecular ions (O_2^+ and NO^+) to atomic ions (O^+) is set out. The results are presented of measurements of electron and ion temperatures and electron density achieved under the conditions given with a good accuracy in altitude (cf Chap. III). The main characteristics of the diurnal electron temperature behavior are pointed out and compared to those which can be evaluated from the ultraviolet radiation of the Sun. In this way is calculated the heat flux issued from the magnetosphere as also the quantity of energy which must be provided to the electron gas to cancel the losses due to the electrons–ion and electron–neutral collisions. These quantities are compared to the theoretical estimates which can be made from them. (auth)

34367 EFFECT OF ELECTRON DENSITY IRREGULARITIES ON PROPAGATION OF VLF WAVES IN THE IONOSPHERE. Aubry, M. P. **Ann. Geophys., 24: 39-48(Jan.-Mar. 1968). (In French).**

The data provided by the FR-1 satellite have shown the presence of scintillations in the vlf field distribution at 750 km. These scintillations are a frequent phenomenon at latitudes higher than 50°N, and they are associated with a large dispersion of the vlf wave normal pattern. They seem to be produced by the irregularities that are responsible for spread-F phenomena. The following problems are discussed: Are some of the vlf waves trapped in field-aligned waveguides at 750 km altitude? What is the influence of the F region irregularities on the vlf propagation? (auth)

34368 ERRORS IN THE METHODS OF DETERMINATION OF THE TOTAL ELECTRON CONTENT BY MEASUREMENT OF THE FARADAY-DIFFERENTIAL EFFECT. **Bertin, F.; Papet-Lepine, J. (Faculte des Sciences, Paris). Ann. Geophys., 24: 63-74 (Jan.-Mar. 1968). (In French).**

Different sources of errors which affect the value of the total electron content calculated by two different methods generally employed for this purpose are analyzed—errors of experimental origin, errors due to the geometrical effect, the influence of the maximum ionization height variation, and errors of theoretical order. A small error is introduced by using a limited development of the refractive index and by neglecting the influence of refraction on the optical paths of the two waves. A more important error is introduced by supposing the factor M as a constant along the optical-ray trajectory between the satellite and the observer. (auth)

34369 FORENOON BITE-OUT OF F2 LAYER IONIZATIONS AT TROPICAL LATITUDES. **Rastogi, R. G.; Sanatani, S. (Physical Research Lab., Ahmedabad, India). Ann. Geophys., 24: 75-80(Jan.-Mar. 1968).**

The decrease of f_0F2 at subtropical stations in the forenoon hours was studied. The bite-out is experienced predominately during solstitial months and more during minimum than during maximum sunspot period. The bite-out is often accompanied by the occurrence of extra critical frequencies and loop traces. The bite-out is found to occur first at the height of the F2 peak and is delayed with decreasing height and is not observed below the height of maximum ionization in the F1 layer. The phenomenon is due to the thermal heating of the upper atmosphere following the sunrise layer through dynamic features contribute to the occurrence of complex ionograms during the bite-out period. (auth)

34370 NOISE BANDS IN THE IONOSPHERE: INCOHERENT GYROMAGNETIC RADIATION OF SUPERTHERMAL ELECTRONS. **Lacombe, C. (Observatoire de Meudon, Hauts-de-Seine, France). Ann. Geophys., 24: 81-9(Jan.-Mar. 1968). (In French).**

An attempt is made to explain the origin of the ionospheric radio noise bands observed in regions III and IV during some space experiments above the F2 layer. In region III where the extraordinary mode refractive index is appreciably greater than 1, an incoherent emissivity of Cherenkov and gyromagnetic radiation of superthermal electrons trapped in the inner Van Allen belt was calculated; a numerical evaluation of an upper limit of the refractive index deduced from space measurements of antenna resistance in region III was used to obtain an energy balance in region III, absorption of the radiation was evaluated. This gives a radiation temperature in agreement with some experimental measurements; the calculated radiation polarization is also very close to the polarization measured by the UK2 satellite. Furthermore, using Poeverlein's construction it is shown that only a very small part of region III radiation can escape by coupling outside of the ionosphere. Conversely the galactic radio noise propagated by coupling down to region III is too weak to explain the high radiation temperatures observed in this region. (auth)

34371 IONOSPHERIC EFFECTS OF NUCLEAR EXPLOSIONS. II. **Kotadia, K. M. (Gujarat Univ., Ahmedabad, India); Jani, K. G.; Rawer, K. Ann. Geophys., 24: 91-100(Jan.-Mar. 1968).**

Changes of virtual and true heights of ionization were analyzed at Freiburg and Dourbes for five cases of strong nuclear explosions in the atmosphere, distant by more than 2000 km. After the arrival of the first blast, important quasi-periodic changes are found (periods greater than 30 min). These oscillations are explained as being due to atmospheric gravity waves. From the time shift of changes of iso-electronic surfaces follows an upward propagation, at least during the first hours. However, the changes of electron density seem to be earlier at greater heights. A maximum effect is found near 230 km, a minimum near 180 km. Amplitude relations are complex and extremely irregular. (auth)

34372 COMMENTS ON BARBIER'S FORMULA FOR THE INTENSITY OF THE 6300 A NIGHTGLOW. **Peterson, Vern L. (Environmental Science Services Administration, Boulder, Colo.). Ann. Geophys., 24: 101-7(Jan.-Mar. 1968).**

Barbier's formula, which relates ionospheric F-region parameters to the intensity of the 6300 Å nightglow, is derived from theory, with close attention being paid to the approximations that enter the derivation. Alternative forms of the formula are derived and tested against observations. The form given by Barbier is found to be usually the best. It is shown that Barbier-type formulae cannot be used to give reliable evaluations of the molecular oxygen scale height, contrary to the conclusions of some other workers. (auth)

34373 FORBIDDEN LINES OF O I AND N I IN THE NIGHT AIRGLOW AT THE MAGNETIC EQUATOR. **Weill, G.; Fehrenbach, M.; Morguleff, N.; Christophe-Glaume, J. (Institut d'Astrophysique, Paris). Ann. Geophys., 24: 109-14(Jan.-Mar. 1968).**

Preliminary results of night airglow measurements obtained in Debre Zeit (Ethiopia) in the winter of 1966–1967 are presented. The lower layer of λ5577 is probably at its worldwide minimum radiance near the equator. The λ5577/6300 ratio in the upper altitude emission is shown to be somewhat variable, presumably as a function of altitude. Intertropical arcs are closely controlled by magnetic activity and so is the diurnal variation of F-region airglow at the equator. The green doublet of NI at /5199 was regularly recorded and highly correlated to λ6300 intensities. It is usually very weak, and on one occasion rose to 33 Rayleighs (zenith). The observations are consistent with production of N (2D) by electronic dissociative recombination of NO +. (auth)

34374 CHARGED PARTICLE FLUXES IN THE INNER VAN ALLEN BELT PRIOR TO THE JULY 9, 1962 HIGH-ALTITUDE NUCLEAR TEST. **Kuck, George A. (Cambridge Research Labs., Bedford, Mass.). Ann. Geophys., 24: 123-8(Jan.-Mar. 1968).**

Charged particles were measured in the inner Van Allen belt on December 19, 1961 by a phoswich scintillator at $B = 0.160$, $L = 1.25$. When fit with a differential exponential spectrum, the lower limit of the pre-Starfish flux of mirroring electrons at this point was found to be $N_e(E) = 2.4 \times 10^6 \exp(-2.6\ E)$ electrons-(cm^2-sec-ster-MeV)$^{-1}$ for electrons with $0.3 < E < 1.0$ MeV. The flux of mirroring protons when fit to a differential exponential spectrum was $N_p(E) = 33. \exp(-.11\ E)$ protons-(cm^2-sec-ster-MeV)$^{-1}$ for protons with $1 < E < 10$ MeV. The proton fluxes agree with those measured by solid-state detectors on Injun I while the electron fluxes confirm the assumptions made by O'Brien when estimating the flux of electrons with $E > 0.6$ MeV in the heart of the inner Van Allen belt. (auth)

34375 RADIAL DIFFUSION PROCESSES OF RELATIVISTIC OUTER-BELT ELECTRONS. **Paolini, F. R. (American Science and Engineering, Cambridge, Mass.); Theodoridis, G. C.; Frankenthal, S.; Katz, L. Ann. Geophys., 24: 129-35(Jan.-Mar. 1968).**

Energy spectra for electrons of 1 to 4 MeV were obtained at low altitudes in the outer belt with a scintillation spectrometer aboard Hitch-hiker I during July and August 1963. Observed time variations and spatial dependence suggest that the transport of relativistic electrons across L shells can be qualitatively understood as the interplay of two processes: (a) radial diffusion with conservation of first and second adiabatic invariants, resulting in spectra monotonously decreasing with L, and (b) radial diffusion arising from shell splitting and pitch angle diffusion, consistent with energy spectra independent of L for L > 4. Process (a) is dominant during magnetically active periods, and (b) is dominant during quiet periods. (auth)

34376 FAST PULSATIONS OF AURORAL-ZONE X-RAY INTENSITY. Kangas, J. (Laboratoire de Physique Cosmique, Meudon, France). Ann. Geophys., 24: 147-52(Jan.-Mar. 1968).

Fast pulsations of auroral-zone x-ray intensity are shown to be characteristic for the morning x-ray events. They give interesting information about electron precipitation into the atmosphere. Energy calculations show that the energy of x rays decreases when fast pulsations appear. This decrease is shown to be accompanied often by an equatorward movement of the electron precipitation region. Comparisons with auroral pulsations show that these two pulsation phenomena can be produced by the same magnetospheric modulation mechanism. (auth)

34377 ORIGIN OF DAY-SIDE AURORAS. Gregori, Giovanni P. (Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome). Ann. Geophys., 24: 153-8(Jan.-Mar. 1968).

The possibility that day-side auroras originate from the tail of the magnetosphere is discussed. The assumption is made that some pressure (hydromagnetic or else) is actually responsible, or at least co-responsible, for the formation of the tail. Under this assumption, a model is tentatively suggested and discussed. Further to the "neutral sheet," a "polar neutral sheet" could exist. The implications of such a model on the particle injection and acceleration in the magnetosphere are considered. It is shown that, even by a very general and qualitative argument, it is possible to explain the seasonal behavior of the auroral frequency distribution. The possibility of testing such a model is also discussed. (auth)

34378 ON THE INFLUENCE OF THE MOON ON THE AURORAL ACTIVITY. Stoffregen, W. (Uppsala Ionospheric Observatory). Ann. Geophys., 24: 159-62(Jan.-Mar. 1968).

Auroral data from a great number of all-sky cameras operating during the IGY show a pronounced periodicity of about 29.5 days, the lunar synodic period. This periodicity is suggested to result from the Moon's influence on the interaction between the solar wind and the geomagnetic field rather than caused by interference of moonlight on visual auroral observations as proposed earlier. (auth)

34379 LOCATION OF HYDROGEN EMISSION WITH RESPECT TO AURORAL FORMS. Derblom, H. (Uppsala Ionospheric Observatory). Ann. Geophys., 24: 163-6(Jan.-Mar. 1968).

Statistical analysis of spectrophotometer records from the subauroral station Lycksele, Sweden during 1960–61 indicated that auroral hydrogen emission appeared south of the main aurora before midnight and north of it after midnight. Some recent measurements with photometers scanning along a meridian support in the earlier result. In the evening the brightest part of the hydrogen emission appears about 5 to 20° south of the main aurora. After midnight the hydrogen emission peak is often found about 3 to 10° north of the aurora. The cross-over time seems to be around local midnight. (auth)

34380 SPECTRUM OF THE ULTRAVIOLET AURORA. Barth, Charles A. (Univ. of Colorado, Boulder). Ann. Geophys., 24: 167-71(Jan.-Mar. 1968).

The spectrum of the ultraviolet aurora consists of the atomic oxygen lines at 1304 and 1356 Å, the atomic nitrogen lines at 1200 and 1493 Å, and the molecular nitrogen Lyman–Birge–Hopfield system with the most intense bands at 1325, 1354, and 1384 Å. Calculations of the excitation of these emissions are compared to rocket observations of the ultraviolet aurora. (auth)

34381 AURORAL O_2 DISSOCIATION AND THE INFRARED OH EMISSION. Maeda, Kaichi (Goddard Space Flight Center, Greenbelt, Md.). Ann. Geophys., 24: 173-84(Jan.-Mar. 1968).

It is shown that the dissociation of molecular oxygen in the polar upper atmosphere caused by auroral particles is accompanied by the increase of ozone in the dissociating layer, contrary to that due to the solar uv radiation. Since the hydrogen–ozone reaction is one of the most effective sources for the atmospheric hydroxyl emission (OH vibrational–rotation band airglow), one would expect an enhancement of the OH emission, following auroral O_2 dissociation. Present calculations based on time-dependent chemical equations for the hydrogen–oxygen atmosphere indicates, however, that the enhancement of OH emission does not occur unless the primary auroral particles penetrate below the 80-km level. One can conclude therefore that the intensity of OH-infrared emission will not enhance during usual bright auroras, except in the lower borders of the so-called (purplish-red) Type B auroras. The extension of the Monte Carlo calculation of the electron diffusion in the upper atmosphere to the case of the atmosphere with constant vertical magnetic field is also presented, indicating a drastic confining effect of the magnetic field on the horizontal spread of the impinging electron flux. (auth)

34382 SOME RECENT RESULTS ON THE MEASUREMENT OF HYDROGEN AND HELIUM EMISSIONS IN THE AURORAL ZONE. Eather, R. H. (Rice Univ., Houston, Tex.). Ann. Geophys., 24: 185-92(Jan.-Mar. 1968).

In a search for helium emissions a photometric scanning system with a sensitivity of 0.05 R/A failed to detect any λ5876/He I emission in the auroral zone. An emission feature in this region was found to be part of the 8–2 hydroxyl system. Upper limits of 0.02 to 0.003 are placed on the λ5876/Hβ ratio and the corresponding α-particle/proton ratios are calculated as functions of particle energy. The ratios of the intensity of λ3914 N_2^+, λ4709 N_2^+, λ5577 O I, and λ6300 O I to the Hβ intensity were measured in proton-excited auroras. The ranges in measured ratios (described by one standard deviation from the mean) are 10.0 to 17.5, 0.9 to 1.3, 9.0 to 12.5, and 2.5 to 3.3, respectively; and these are in reasonable agreement with theoretical predictions. Recommended values to use for the ratios are 17.0, 1.0, 10.0, and 3.0, respectively. The results may be used to estimate the relative importance of proton and electron excitation in auroras. (auth)

34383 ION AND ELECTRON HEATING BY AURORAL ELECTRIC FIELDS. Rees, M. H. (Univ. of Colorado, Boulder); Walker, J. C. G. Ann. Geophys., 24: 193-9(Jan.-Mar. 1968).

Heating of ions and electrons by electric fields associated with the auroral electrojet was investigated. Electric fields normal to the magnetic field can produce electron heating rates comparable to those produced by the secondary auroral electrons. Ion heating rates are so large that the ion temperature can attain values 1000°K in excess of the gas temperature at 200 km. Under conditions of little or no particle bombardment an electric field normal to the magnetic field can raise the ion temperature above the electron temperature. (auth)

34384 ORIGIN OF THE DIFFUSE RADIO AURORA. Unwin, R. S. (Physics and Engineering Laboratory Auroral Station, Omakau, New Zealand). Ann. Geophys., 24: 201-8(Jan.-Mar. 1968).

On the hypothesis that the diffuse radio aurora is produced by the two-stream plasma instability of Farley, the origin of the electric field necessary to produce the instability is sought. The electric field which drives the westward auroral electrojet is suggested as the cause of the early morning peak in diffuse echo occurrence observed from Bluff, New Zealand. The electric field produced in the ionosphere by the solar-wind driven convection in the magnetosphere, on the assumption that the geomagnetic field lines are equipotentials, is given as the cause of the strong peak in diffuse echo occurrence on the evening side. Calculations from an extremely simplified model due to Nishida (1966) predict a symmetrical distribution of electric field strength about the noon–midnight meridian. It is suggested that the observed asymmetry in diffuse echo occurrence is due to the asymmetry in the solar-wind plasma flow round the nose of the magnetosphere. Some differences in the occurrence of the diffuse radio aurora at conjugate points are predicted. The value of auroral radar backscatter observations in providing information on magnetospheric convection is pointed out. (auth)

34385 RADAR AURORA AND PLASMA INSTABILITIES. Gadsden, M. (Environmental Science Services Administration, Boulder, Colo.). Ann. Geophys., 24: 209-13(Jan.-Mar. 1968).

Due largely to the analysis and interpretation of vhf backscatter from the equatorial electrojet, discussion of the radar aurora in terms of plasma instabilities in the ionospheric E region has led to a significant increase in the understanding of this phenomenon. This paper is an attempt at a brief review of this discussion and leads to suggestions for further observations of the radar aurora at the time of the imminent maximum of solar activity. (auth)

34386 VISCOUS MAGNETOSPHERIC BOUNDARY LAYER. Faye-Petersen, R.; Heckman, G. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Ann. Geophys., 24: 347-57(Jan.-Mar. 1968).

Recently a great deal of attention has been directed to the hypothetical phenomenon of a "viscous-like" interaction between the solar wind and the Earth's magnetosphere. This viscous interaction causes a surface frictional force that drags the boundary downstream. A rationale for a viscous collisionless plama as used in this paper, is based on a pressure tensor pertubation associated with a perturbation mechanism in the ion cyclotron gyration orbit. A MHD continuum boundary-layer analysis is performed for the magnetosphere interface between the shocked field-aligned magnetosheath and the geomagnetic field confined in the quiescent magnetosphere plasma region. Based on the compressible MHD boundary layer equations discussed by Lessen and Deshpande (1966), this analysis gives profile solutions of the proton velocity, magnetic field, and proton number density at typical intervals along the magnetospheric boundary. The boundary layer solutions for thickness, shear stress, and magnetic stress are obtained in terms of an analytical expression for gyroviscosity and subsequently correlated with orders-of-magnitude figures for the viscous drag and energy dissipation previously estimated for the magnetosphere. A balance is recognized at the magnetosphere boundary between a viscous stress in the boundary layer and a magnetic stress arising in the adjoining geomagnetic field. (auth)

34387 SPECTROSCOPY AND EXCITATION. Omholt, A. (Auroral Observatory, Tromsoe, Norway). Ann. Geophys., 24: 215-26(Jan.-Mar. 1968).

A brief review is given of the work performed in auroral spectroscopy and on excitation mechanisms in aurora during the last four years. The intensity ratio λ5577/3914 and the relation between the λ3914 emission, the rate of ionization, and the resulting electron density are discussed. A full understanding of these problems is important to make auroral light measurements a more useful tool for studies of particle impact morphology and ionospheric phenomena associated with aurora. Short reviews are given of the work on the red oxygen lines and the use of Hα and Hβ observations for studies of proton impact and on temperature measurements by auroral spectroscopy. Finally, important work on some other spectral features is summarized. A list of papers on laboratory and theoretical work related to auroral spectroscopy and excitation mechanisms is collected in the Appendix. (auth)

34388 POLAR DAILY GEOMAGNETIC DISTURBANCES. Matsushita, S. (High Altitude Observatory, Boulder, Colo. Univ. of Colorado, Boulder). Ann. Geophys., 24: 227-39(Jan.-Mar. 1968).

It is well known that the polar region shows daily geomagnetic disturbances even on low Kp or Ap days. These geomagnetic variations in the northern and southern polar caps for three seasons during the IGY were re-examined with respect to different coordinate and time systems. Responsible overhead current systems in both polar caps were estimated and were compared with those obtained by other workers. An interesting correlation was found between the current pattern and the region where the ionospheric blanketing sporadic E frequently occurred. A cause of polar daily geomagnetic disturbances is discussed briefly based on this correlation. (auth)

34389 PHYSICAL ASPECT OF PC 3 AND PC 4. Fanselau, G. (Geomagnetic Inst., Potsdam, Ger.). Ann. Geophys., 24: 241-3 (Jan.-Mar. 1968).

This paper is related to investigations into the microstructure of pc 3 and pc 4 pulsations. Main aims of the investigation were special problems of the polarization direction of the pulsation vector horizontal component. A mean polarization direction can be significantly found, which is about 41° for Wingst and about 38° for Niemegk. Some comparisons with various theories are made as to the dependence of the period continuance on latitude as it was found in a former paper. (auth)

34390 OBSERVATIONS OF GEOMAGNETIC PULSATIONS: PC 3, 4, AND PI 2 AT DIFFERENT LATITUDES. Voelker, H. (Univ., Goettingen, Ger.). Ann. Geophys., 24: 245-52(Jan.-Mar. 1968).

The results are given of a direct comparison of pulsations simultaneously recorded with standardized equipment on a north-south profile from the auroral zone in Northern Scandinavia to Germany. This comparison has yielded a systematic increase of the period with increasing geomagnetic latitude, as far as the H components of pc 3-type daytime pulsations are concerned. The latitude dependence of the period occurs also for other daytime pulsations, called pulsational single effects (pse), having the shape of a damped oscillation and being superimposed to ssc's and si's. The distribution of the periods of these pulsations is plotted as a function of geomagnetic latitude covering the range from 20 to 68°. A direct comparison of the pulsation records from observatories having a longitude difference of 135°, and a statistical investigation of effects recorded at stations in Europe, exhibit a distinct local-time dependence of the simultaneous appearance of pulsations together with ssc's or si's: Pulsations with latitude dependent periods are confined to the sunlit hemisphere. At times near sunrise and sunset the ssc's and si's are frequently accompanied by pi2-type pulsations. Around local midnight the simultaneous generation of pulsations and ssc's or si's is rarest. (auth)

34391 CRITICAL STUDY OF THE POSSIBLE MODES OF PROPAGATION OF PI 2 MICROPULSATION ACTIVITY OVER THE EARTH'S SURFACE. Rostoker, Gordon (Univ. of British Columbia, Vancouver). Ann. Geophys., 24: 253-60(Jan.-Mar. 1968).

The characteristics of the possible modes by which pi 2 micropulsation activity may propagate over the Earth's surface are discussed and specific characteristics which may be studied experimentally are outlined. The results of previous experimental work are combined with the results of an experiment recently performed by the author to rule out several of the proposed modes of propagation. It is found that pi 2 micropulsations most likely propagate from the auroral zone to midlatitude regions through the lower region of the ionosphere. The energy may be considered to be transferred by a wave mode which has the properties of an electromagnetic wave propagating through a solid conductor. (auth)

34392 POLARIZATION AND SPECTRAL CHARACTERISTICS OF SOME HIGH-LATITUDE IRREGULAR GEOMAGNETIC MICROPULSATIONS. Paulson, K. V. (Univ. of Saskatchewan, Saskatoon). Ann. Geophys., 24: 261-6(Jan.-Mar. 1968).

The hodogram method for determining polarization is not suitable when applied to data that have irregularities in their structure. For such data, Wiener's method of describing the polarization of a two-dimensional, time-varying field should be used. This method was applied to two cases of geomagnetic micropulsations recorded at Kiruna during two of the five most disturbed days of November, 1963. The spectra of the polarized components were found to be similar, with a decrement of about 20 dB between 1 and 15 mHz. Significant spectral peaks were found in both the polarized and nonpolarized spectra. Except for a few exceptions, polarization was nearly linear in the frequency interval from 1 to 59 mHz. For both cases the degree of polarization was fairly high over the lower part of the 1- to 59-mHz frequency range and then decreased. Over the first part of this range the polarization angles fluctuated about a value of 40 to 50 degrees east of geomagnetic north and then changed fairly abruptly to values in the opposite direction. (auth)

34393 IRREGULAR MICROPULSATIONS AND THEIR RELATIONS WITH THE FAR MAGNETOSPHERIC PERTURBATIONS. Gendrin, R.; Lacourly, S. (CNET, Issy-les-Moulineaux, France). Ann. Geophys., 24: 267-73(Jan.-Mar. 1968).

A classification of irregular pulsations in the frequency range 0.1 to 3 Hz is given. An attempt is made to connect each class of event with other geophysical perturbations. This study gives more details about irregular pulsations of diminishing period (I.P.D.P.). Satellite measurements of trapped electrons and magnetic fields in the magnetosphere and in the tail allow one to locate the origin of these emissions. (auth)

34394 SATELLITE AND ROCKET PARTICLE OBSERVATIONS IN THE AURORAL ZONE. Maehlum, Bernt N. (Rice Univ., Houston, Tex.). Ann. Geophys., 24: 275-84(Jan.-Mar. 1968).

The average variations in the charged particle fluxes near the auroral zone have been studied by a vast amount of data obtained by polar orbiting satellites. On the other hand, studies of "fine structure" in the particle fluxes within and near auroral forms have not yet reached any consistent picture, mainly because the data available is very limited. In the present paper the average particle observations are briefly reviewed, whereas some of the recent experimental studies of "fine structure" in the particle energy and pitch-angle distribution are discussed in more detail. (auth)

34395 COORDINATED ROCKET MEASUREMENTS OF AURORAL PARAMETERS. Baker, K. D. (Univ. of Utah, Salt Lake City). Ann. Geophys., 24: 285-9(Jan.-Mar. 1968).

Measurements of electron densities and auroral light emissions were made on a series of multiply instrumented rockets fired into visible auroral displays. In diffuse, relatively dim auroral regions (several kilorayleighs of 5577 Å emission) the maximum electron densities of the E_{s2} layer were about 2×10^5 electrons/cm^3, while in the brighter auroral forms (IBC II) the densities were about a factor of 4 larger. The relative intensities and spatial distribution of auroral emission lines as determined from the in situ measurements are discussed. The ratio of 5557 Å (O I) to 3914 Å (N_2^+) intensity was found to be about 2, independent of altitude up to 190 km. The interrelations between charged-particle densities, auroral light emission, and energetic electron fluxes based on the rocket measurements are summarized. (auth)

34396 SYSTEMATICS OBSERVED IN THE ENERGY AND ANGULAR DISTRIBUTIONS OF AURORAL ELECTRONS. Sharp, R. D.; Johnson, R. G. (Lockheed Research Lab., Palo Alto, Calif.). Ann. Geophys., 24: 291-4(Jan.-Mar. 1968).

Measurements of auroral particle precipitation were performed with instruments on a low-altitude polar-orbiting satellite during the period Oct. 30, to Nov. 4, 1963. The observations were made at local times of approximately 0100 and 1300 hours. Interesting systematics were observed when the simultaneous outputs from various detectors were plotted against each other. The angular distributions of the electrons precipitating at different locations within a zone were found to become more uniform as the intensity of the precipitation event increased. Occasionally a dramatic ordering of the spectral data from the entire zone traversal was observed, with the spectral hardness increasing with the intensity of the precipitation. These systematics may provide useful constraints on theoretical models for auroral source mechanisms. (auth)

34397 VARIETY OF PARTICLE PHENOMENA DISCERNIBLE AT THE GEOSTATIONARY ORBIT VIA THE ATS-1 SATELLITE. Freeman, J. W. Jr.; Maguire, J. J. (Rice Univ., Houston, Tex.). Ann. Geophys., 24: 295-303(Jan.-Mar. 1968).

The purpose of this paper is to provide a brief catalog of the three most salient phenomena that have been observed with the Rice University ion detector aboard the ATS-1 synchronous orbit satellite. These phenomena are a gross pre-post/midnight asymmetry in the enhanced energetic charge particle fluxes observed on the night side of the earth, a magnetopause penetration to 6.5 R_E with the subsequent detection of discrete clouds of energetic particles executing repeated longitudinal drift about the Earth, and bursts of very low energy, $E < 50$ eV, highly directional positive ions tentatively associated with hydromagnetic transients. Each of these phenomena are described in sufficient detail to illustrate the prominent facts. (auth)

34398 AURORAL MEASUREMENTS USING ROCKET-BORNE PHOTOMETERS. Miller, J. R.; Shepherd, G. G. (Univ. of Saskatchewan, Saskatoon). Ann. Geophys., 24: 305-12(Jan.-Mar. 1968).

A discussion is presented on the problems encountered in making photometric measurements of aurora from rockets. A two-channel photometer developed at the University of Saskatchewan is briefly described. The discussion is illustrated with data from two rocket flights, one a measurement of the Hβ emission in hydrogen aurora, the other a measure of the O I 5577-Å and N_2^+ 4278-Å distributions and the rotational temperature from the latter emission. The hydrogen aurora was relatively free of temporal variations, but the 4278- and 5577-Å volume emission rate profiles could only be obtained by referring to ground-based measurements of the temporal variations. The volume emission rate profiles for the two emissions are significantly different. The rotational temperature shows very little change with height; this result is not at all understood. (auth)

34399 OBSERVATION OF VLF-RADIO NOISE IN THE IONOSPHERE DURING AN AURORAL ABSORPTION EVENT. Iversen, I. B.; Olesen, O. H.; Ungstrup, E. (Danish Space Research Inst., Lyngby). Ann. Geophys., 24: 313-16(Jan.-Mar. 1968).

Strong vlf-signals were observed on a rocket fired during auroral absorption conditions shortly before local midnight, June 26, 1966 from Andoya, Norway. Emissions in the polar chorus band 500 to 1,000 Hz were observed throughout the part of the trajectory lying above 91 km and the flux density reached 2×10^{-13} W/m^2 Hz. These signals showed no spin modulation. Also hiss was observed over a large part of the trajectory. It showed fluctuations both in amplitude and spectrum. Some of the hiss bursts were spin-modulated and others were not. As the hiss was not observed on the ground, it is not known whether it was limited in time or space. The conditions for vlf reflection and absorption within the lower region of the ionosphere are considered. (auth)

34400 DEVELOPMENT OF STORMS IN THE LOWER IONOSPHERE AT MEDIUM LATITUDES. Gloede, P.; Knuth, R.; Lauter, E.-A. (Observatory for Ionospheric Research, Kuehlungsborn, Ger.). Ann. Geophys., 24: 317-23(Jan.-Mar. 1968).

Observations of ionospheric absorption (A3 method) and phase height of low frequency radio waves have been carried out by a network of stations in middle and south-eastern Europe for many years, completed by radio aurora observation at Kühlungsborn ($\Phi = 54{,}4°$N). Radio aurora is observed in medium latitudes only during strong magnetic storms and seems to originate from a very narrow height interval at a constant altitude. Simultaneously, the A3 records show abnormal absorption and/or fast fading of the sky wave field strength on paths with reflection points north of a certain boundary-latitude, shifting more or less southwards according to the intensity of the storm. The storm events of May 25–26, 1967, Sept. 3–4, 1966 and Feb. 16, 1967, are discussed as typical examples for the different forms of mid-latitude storm effects in the lower ionosphere. (auth)

34401 ION-ACOUSTIC WAVES MODIFIED BY GRAVITY. Poeverlein, H. (Cambridge Research Labs., Bedford, Mass.). Ann. Geophys., 24: 325-32(Jan.-Mar. 1968).

The theory of hydromagnetic waves is made applicable to periods or time constants of some hours or one day by including the gravity force and assuming a joint motion of plasma and neutral gas in the atmosphere. Ion-acoustic waves, resulting from the passage of modified Alfvên waves through the stratified atmosphere, are severely modified by gravity. The ion-acoustic waves in the modified form represent the low-frequency limiting case of both the ion-acoustic waves in the plasma and the gravity waves in the neutral atmosphere. Two ion-acoustic modes are distinguished, both evanescent, but connected with different ratios of density variation to material velocity. Both are guided along the magnetic force lines. A propagated slow wave mode is obtained in the plasma without co-motion of the neutral gas, if the lifetime of ions is limited to less than an oscillation period. (auth)

34402 SOLAR WIND INTERACTIONS. A Review. Dessler, A. J. (Rice Univ., Houston, Tex.). Ann. Geophys., 24: 333-40 (Jan.-Mar. 1968).

The beginning of the present solar wind theory is outlined with particular emphasis on the contributions of Kristian Birkeland. The solar wind interacts with the Moon and with the Earth's magnetic field. Recent experimental evidence indicates that the interaction with the Moon is in the form of undeviated flow with negligible "piling up" of interplanetary magnetic field ahead of the moon. This behavior can be due either to an electrically insulating dust layer on the lunar surface or to a low bulk conductivity for the Moon. A standing shock wave trailing the Moon has been predicted by Michel. The solar wind interacts with the geomagnetic field and confines it to a cavity with a long geomagnetic tail stretched out in the anti-solar direction. The problem of magnetic merging in the tail is discussed. (auth)

34403 SEASONAL AND CYCLIC VARIATIONS OF THE NON-DEVIATING ABSORPTION IN THE D REGION OF THE IONOSPHERE. Nestorov, Georgi. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 9: 31-42(1966). (In Russian).

The contribution of the non-deviating absorption in the D region is determined on the basis of the constant value, established by the author, of the deviation absorption due to constancy of the zenith angle of the Sun. Use is made to this end of the data from the registrations obtained in Sofia of the intensity of the electromagnetic field from the Stara Zagora transmitter with a frequency of 1.223 Mc for the 1960–1965 period. A seasonal course of the absorption is obtained with a minimum at about the spring equinox and maximum during the winter months (November–December). The seasonal variations of the absorption, the winter anomaly in particular, are explained by aeronomic processes in the region of the mesosphere and not with variations of the ionizing radiation. A negative correlation is obtained ($r = -0.91$) between the averaged values of the absorption and the lower limit of the D region. The author shares the opinion that the intensification of the winter anomaly in the northern regions is due to the high temperature gradients above the mesopause. (Abstr. Bulg. Sci. Lit.)

34404 STRATIFICATIONS AND FINE STRUCTURE OF THE E LAYER. Serafimov, Kiril. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 9: 73-90(1966). (In Russian).

The boundary precision of the measurements and the interpretation of the frequencies in the E layer and its stratifications are analyzed. It is pointed out that the nonoperative drift between two adjacent irradiated impulses was not taken into consideration until now in evaluating the precision. Methods of improving precision are shown. A classification is made of the reflected traces above or in the E layer with a group delay in the signal in three groups. The method employed and the results obtained at the specialized observations of the stratifications in the E layer in Sofia are described. Stratifications were established on all parts of the trace Z′(f). Possibilities are established of investigating the stratifications in the E layer by standard ionosphere problem. Detailed analyses are made of the daily and seasonal drift of the relative number of stratifications, and of the course depending on the solar activity. The greatest number of stratifications are observed several degrees before and after the culmination of the Sun. The connections of the stratifications with the sporadic E layer and the E_α layer are investigated. The possible sources of the stratifications are analyzed, with a more detailed investigation of the influence of a horizontally moving ellipsoid and of unhomogeneity with a wedge-like shape. The stratifications make it possible to define the critical frequency f_0E in about 90% of the cases. (Abstr. Bulg. Sci. Lit.)

34405 REGULARITIES IN THE DEVELOPMENT OF THE F1 LAYER. Serafimov, Kiril. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 8: 65-81(1966). (In Russian).

The problem is examined of the appearance and effect of the movements on the changes of the critical frequencies of the layer F1. It is proved that the movements in the ionosphere affect the form of the dependence f_0F1(t) by introducing a second harmonic member in the diurnal drift and by deforming the cosine law. Using data obtained from 10 ionosphere stations, the moments of the appearance and disappearance of the F1 layer are compared with the changes in the solar activity (1957–1964). A comparison is drawn between the theoretical conclusions and the experimental results obtained. It is pointed out that certain familiar theoretical considerations relative to the division of the F region are in disagreement with the experimental data obtained. The investigations have shown that in the near-maximum part of the F1 layer the neutralization is entirely a recombination of the α type. (Abstr. Bulg. Sci. Lit.)

34406 VARIATIONS OF THE EFFECTIVE COEFFICIENT OF RECOMBINATION IN THE LOWER IONOSPHERE. **Nestorov, Georgi. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 8: 19-30(1966). (In Russian).**

The variations of the components of the equation of the effective coefficient of the recombination α' in the lower ionosphere are investigated under undisturbed conditions. The problem has been examined quantitatively, the variations of α' being explained with the change in the meteorological parameters in the region examined, its position with regard to the Sun, and its ionic composition. Graphs are given for the values of α' and its components for the four seasons of the year, for latitudes of 30, 45, and 60°, for values of the zenith angle of the Sun of 40°, 60, 75, 85, 95, and 100° and also for all heights 60 to 90 km of the D region. For typical day conditions the value obtained for α' is 2 to 5×10^{-7} cm^3/sec in the essential part of the D region 70 to 90 km. (Abstr. Bulg. Sci. Lit.)

34407 DISTRIBUTION OF ELECTRON DENSITY TAKING ACCOUNT OF THE STRATIFIED STRUCTURE OF THE IONOSPHERE. **Potapova, Nadezda; Serafimov, Kiril. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 9: 53-60(1966). (In Russian).**

Serafimov's method of obtaining the structure of the intermediate E–F region has been expanded for the entire mean and high ionosphere. Use is made to this end of a parabolic approximation of the area of the maximum of the E layer, taking account of the lower-lying ionization. A profile calculated after an ordinary method on a electronic computer is used for the near-maximum part of the F region. The connection of these two profiles takes place with an extremum distribution N(z). To this end the unknown profile N(z) is expanded in Taylor series whose unknown coefficients are found under certain conditions. The latter make it possible to find 6 + 8 coefficients of the polynomial for N(z). The method is applied to an ionogram from the corresponding stations; for this ionogram a nonextremum profile has been realized on an electronic machine. A four-maximum distribution N(z) was obtained for the entire ionosphere without the D region. The maxima correspond to layers E, E2, F1, and F2. It is believed that the results obtained show the considerable investigatory possibilities of the method. (Abstr. Bulg. Sci. Lit.)

34408 IONIZATION IN THE NEAR-MAXIMUM PART OF THE E LAYER. **Serafimov, Kiril; Letfus, Vojteh. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 9: 61-72(1966). (In Russian).**

An expression for the characteristic number J_E is found on the basis of the full form of the equations related to the ionization–neutralization balance in the E layer. The expression obtained is very complex and its calculation requires knowledge on the seasonal changes of the recombination coefficient and the vertical gradient of the velocity. This expression is simplified under certain substantiated simplifying conditions. After data obtained from the Sofia Station for a period of one year, numerical values were obtained for the characteristic number which are compared with the changes in the intensity of the soft solar x radiation in the range of $\lambda = 40$ to 60 Å, the relative number of the solar spots, and the radio radiation of the Sun at frequencies of 1500 to 2800 Mc. It is shown that the daily values of the characteristic number for the E layer correlate ($R = 0.69$) practically with the solar x radiation alone. Hence, it is concluded that the predominant ionizing source of the E layer is the soft x radiation. (Abstr. Bulg. Sci. Lit.)

34409 A NOTE ON THE NUMBER OF GEOMAGNETIC STORM SUDDEN COMMENCEMENTS RECORDED AT ADDIS ABABA. **Gouin, P. Bull. Geophys. Observ., Haile Sellassie I Univ., No. 10, 3-13(1967).**

It is concluded from investigations of the frequency distribution of sudden commencements, identified over the 9-year period of operation of the Geophysical Observatory at Addis Ababa (January 1958–66), that storm sudden commencements are recorded at the magnetic equator as well as at any other latitude; the number of sudden commencements recorded per year increases with solar activity; the absolute number of SC* (SC with negative impulse preceding main positive impulse) is not a worldwide characteristic of a given storm; the number of recorded storm sudden commencements seems independent of season, local time, lunar time, and lunar phases, except for n(SC*) which is apparently influenced by position of Sun above local horizon; and the direction of SC onsets at Addis Ababa is not constant but is usually positive in H, D, and Z. (Geophys. Abstr.)

34410 MEAN INTENSITY OF THE ELECTRIC CURRENTS IN THE IONOSPHERE OF THE POLAR CAPS AS A FUNCTION OF THE PLANETARY MAGNETIC ACTIVITY. **Lebeau, Andre; Mendel, Annick (Groupe de Recherches Ionospheriques, Saint-Maur-des-Fosses, France). Compt. Rend., Ser. A and B, 266: 745-7(Mar. 11, 1968). (In French).**

The correlation between the planetary magnetic activity defined by the index A_p and the daily mean I of the mean hourly intensities of the zenith ionospheric current was studied for seven Antarctic observatories. It is shown that at the interior of auroral belts, the mean dependence between I and A_p can be expressed by a relation of the form $I = aA_p^{\alpha}$, $\alpha < 1$; a decreases and α increases when one goes from the pole toward the lower latitudes. On an average I is maximum at the invariant pole; the increase of α with the magnetic colatitude indicates that the current system of the polar caps is extended toward the low latitudes when the magnetic activity increases. (tr-auth)

34411 EQUILIBRIUM F_1-LAYER AT LOW SOLAR ACTIVITY. **Shchepkin, L. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 428-31(1967).**

Translated from Geomagn. Aeron., 7: 532-4(1967).

Processes contributing to the ionization in the ionospheric F1 region are reviewed. (M.O.W.)

34412 DIURNAL VARIATIONS OF ELECTRON CONCENTRATION AND THE CHANGE IN IONOSPHERIC TEMPERATURE AT HEIGHTS OF 160 TO 200 KM. **Kazachevskaya, T. V.; Ivanov-Kholodnyi, G. S. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 433-5(1967).**

Translated from Geomagn. Aeron., 7: 537-9(1967).

Using present-day derivations of the photochemical theory, the character of atmospheric variations over a day was studied, using data on ion composition. The relationships between the parameters of the neutral and ionized portions of the upper atmosphere at the heights in question are examined. (M.O.W.)

34413 LONG-PERIOD VARIATIONS OF THE CUTOFF FREQUENCIES OF THE SPORADIC E-LAYER. **Starovatov, A. A. (Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 436(1967).**

Translated from Geomagn. Aeron., 7: 540(1967).

The data from Alma-Ata for 1942 to 1964 were analyzed. A curve showing the variation of f_0E_s over two solar activity cycles is given. (M.O.W.)

34414 CHANGE IN THE RANGE OF THE SEMITRANSPARENCY OF E_s ACCORDING TO OBSERVATIONS AT ROSTOV-ON-THE-DON. Chavdarov, S. S.; Chernysheva, S. P.; Dubkina, V. P. (Rostov State Univ., Rostov-on-Don, USSR), Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 437-8(1967).

Translated from Geomagn. Aeron., 7: 541(1967).

Curves showing the diurnal variations at Rostov for 1958 to 1964 are discussed. (M.O.W.)

34415 SPORADIC E-LAYER AND MAGNETIC ACTIVITY. **Shvarts, Ya. M.; Andreeva, S. I. Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 438-40(1967).**

Translated from Geomagn. Aeron., 7: 542-3(1967).

Data are given on the distribution of E_s appearance in terms of critical frequencies, f_{cr}, on magnetically quiet and disturbed days. (M.O.W.)

34416 DETERMINATION OF THE INITIAL HEIGHT OF THE IONOSPHERE. **Serafimov, K. B.; Danilkin, N. P. (Inst. of Geophysics, Sofia. Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 440-2(1967).**

Translated from Geomagn. Aeron., 7: 544-6(1967).

A method is proposed for determining z_D on the basis of a combined analysis of the N(z) profile of the ionosphere with allowance for both magnetoionic components of a signal and of data on the absorption coefficient. (M.O.W.)

34417 RELATIONSHIP BETWEEN S_q-VARIATIONS AND DRIFT IN THE IONOSPHERE. **Aroshidze, G. M.: Zagulyaev, V. A.; Kashin, A. A.; Kushnerevskii, Yu. V.; Chikovani, D. S. (Inst. of Geophysics, Tbilisi, USSR. Moscow State Univ. Tbilisi State Univ., USSR. Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 444-6(1967).**

Translated from Geomagn. Aeron., 7: 548-50(1967).

The method of closely spaced reception at three frequencies in the 2 to 8 MHz range was used to study the relationship between

S_q variations of the geomagnetic fields at Dusheti and drifts in the E and F_2 regions at Tbilsi on the day of the May 20 solar eclipse in 1966. (M.O.W.)

34418 DETECTION OF LYMAN-β AND HELIUM RESONANCE RADIATION IN THE NIGHT SKY. Young, J. M.; Carruthers, G. R.; Holmes, J. C.; Johnson, C. Y.; Patterson, N. P. (Naval Research Lab., Washington, D. C.). Science, 160: 990-1(May 31, 1968).

A rocket-borne photometer has detected far ultraviolet night glow radiations that are identified as Lyman-β (H I 1026 Å), and the helium lines at 304 or 584 Å, or at both. At an altitude of 227 km the measured intensity for Lyman-β was about 10 rayleighs. The discrimination characteristics of the broad-band helium radiation filter give helium line intensities, at 227 km, of 4.8 and 12 rayleighs, respectively, pending identification of the wavelength of the radiation as 304 or 584 Å. These ultraviolet radiations appear sufficient to maintain the night E and F1 regions of the ionosphere. (auth)

34419 SHORT-PERIOD PULSATIONS OF AURORAL COSMIC NOISE ABSORPTION. Roldugin, V. K. Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 454-6(1967).

Translated from Geomagn. Aeron., 7: 559-60(1967).

The intensity of auroras and of cosmic noise absorption was recorded at Laparskaya in the winter of 1965-1966 at a frequency of 13 MHz on a multichannel recorder to detect short-period pulses of absorption. It was found that strong auroral pulsations are sometimes accompanied by absorption pulsations. (M.O.W.)

34420 MEASUREMENT OF THE GEOMAGNETIC FIELD COMPONENTS IN THE PLANE OF THE MAGNETIC MERIDIAN AT SEA BY THE NUCLEAR-PRECESSION METHOD. Rotshtein, A. Ya. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 411-14(1967).

Translated from Geomagn. Aeron., 7: 512-15(1967).

Methods of measuring the components with a nuclear-precession magnetometer and their efficient use, depending on the magnetic latitude of the measurement site, are examined. It is shown that use of this method eliminates the necessity of orienting the instrument along the magnetic meridian in measurements at any point on earth and does not require, in most cases, determination of the magnitude of three vectors. (auth)

34421 POSSIBLE COLLECTIVE SOLAR COSMIC-RAY INJECTION INTO THE GEOMAGNETOSPHERE. Miroshnichenko, L. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 426-7(1967).

Translated from Geomagn. Aeron., 7: 530-1(1967).

The critical flux for possible solar-ray injection into the geomagnetosphere is discussed. (M.O.W.)

34422 SPACE-TIME DISTRIBUTION OF IONIZATION IN THE F_2 REGION OF THE IONOSPHERE AT HIGH LATITUDES IN THE SOUTHERN HEMISPHERE. Gukin, G. V.; Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 373-7(1967).

Translated from Geomagn. Aeron., 7: 463-8(1967).

The space-time distribution of anomalous ionization in the F2 region at high latitudes in the Southern Hemisphere is analyzed. It is found that the diurnal patterns of f_0 F2 can be approximated by three harmonics, even at high-latitude stations. The latitudinal distribution of ionization as a function of corrected geomagnetic latitude Φ' has two maxima, one in the auroral zone and the other at Φ' of about 78 to 80°S. It is also found that the time of appearance of the ionization maximum in the auroral zone and in the polar region is controlled both by local and universal time. (auth)

34423 ASYMMETRY IN THE DIURNAL VARIATIONS OF THE E-LAYER. Samardziev, D.; Serafimov, K. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 382-8(1967).

Translated from Geomagn. Aeron., 7: 475-83(1967).

The ratios of the forenoon to the afternoon f_0E values are investigated. Theoretically, these ratios are affected by variations in dynamic processes, in the effective recombination coefficient of ionizing radiation, in temperature, in the average mass of ionized components, in the height of maximum electron formation, etc. Furthermore, the diurnal symmetry is disturbed by E_s and stratifications in the E layer itself. A general expression is derived for the coefficient of asymmetry and some specific cases are examined. The theoretically expected asymmetric variations are borne out by the data of several stations for various zenith angles of the sun. In the discussion of the observational results, an explanation is given of the source of asymmetry in the absence of conditions favorable for a quasi-stationary approximation. A rigorous determination of the source of asymmetry may introduce variations of the vertical velocity gradient or variations of α, etc. In the specific cases under examination, the ratios of afternoon to forenoon α values for $\chi = 80°$ are 1.15 to 1.9, which agrees approximately with the results of direct measurements. (auth)

34424 LOW-LYING NIGHTTIME IONIZATION IN THE IONOSPHERE. Potapova, N. I.; Shapiro, B. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 389-94(1967).

Translated from Geomagn. Aeron., 7: 484-91(1967).

Some preliminary results of rigorous computations of nighttime N(h) profiles with allowance for underlying ionization (ionization beyond the low-frequency limit of measurement of an ionospheric station, $f_{\min}$) are presented. The computations were performed on the basis of measurements at the middle-latitude station Moscow during the IGY and IQSY. The results of the rigorous computations are compared with the data obtained by a standard method of computation (without allowance for underlying ionization). The average corrections to the data obtained by the standard method are computed for three IGY seasons. A simplified method of correcting the nighttime N(h) profile is described; it was obtained by the standard method of computation for the o component without repeated analysis of the h'f curve. Estimates of the integral value of the underlying nighttime ionization, J, showed that this value has decreased by approximately half from the IGY to the IQSY (from 10×10^{10} el cm^{-2} in 1958 to 5×10^{10} el cm^{-2} in 1964). It was also noted that J increases during disturbances. At sunrise in winter during years of minimum solar activity the gradients of height h for a fixed frequency $f(dh_f/dt = h_f)$ may exceed the true values by a factor of 5-6, according to the results obtained by the standard method without appropriate corrections. The ionization gradients, N, at a fixed level $h(dN_h/dt = N_h)$ and the ionization rates $q(q \approx N_h)$ at sunrise in winter, computed from the N(h) data by the standard method, are close to the true values. (auth)

34425 AURORAL ABSORPTION IN CONJUGATE REGIONS AT HIGH LATITUDES. Driatskii, V. M. (Arctic and Antartic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 398-402(1967).

Translated from Geomagn. Aeron., 7: 496-501(1967).

The behavior of auroral absorption at two relatively close conjugate points, Mirny in the Antarctic and Heiss Island in the Arctic, is examined. Cosmic noise records obtained at these stations are analyzed. It is found that the intensity of associated events is higher in local winter and absorption is observed somewhat earlier at Mirny than on Heiss Island. The nature of the patterns obtained is discussed. (auth)

34426 REMARKS ON THE INTERPRETATION OF LUNIK-10 MAGNETOMETER RESULTS. Ness, N. F. (Goddard Space Flight Center, Greenbelt, Md.). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 346-51(1967).

Translated from Geomagn. Aeron., 7: 431-5(1967).

Initial interpretation of the Lunik 10 magnetometer data obtained in April-May 1966 led to conclusions that the earth's magnetic tail was absent at the lunar orbital distance. This was not in agreement with results obtained subsequently by Explorer 33 measuring the earth's magnetic tail at and beyond the lunar orbital distance in July-October 1966. Measurements of low-energy plasma fluxes on Lunik 10 indicated traversal through the earth's neutral sheet. Observations of the earth's magnetic tail and the position of the imbedded neutral sheet in April and May 1966 by IMP-3 demonstrate the existence of the tail and neutral sheet simultaneous with the Lunik 10 measurements. Thus, it is necessary to investigate the position of the moon in solar magnetospheric coordinates in order to interpret the Lunik 10 data. When this is done it is found that the magnitude and temporal variation is consistent with the satellite being imbedded in the earth's magnetic tail during full-Moon periods. (auth)

34427 POSSIBLE INTERPRETATION OF THE RESULTS OF MEASUREMENTS ON THE LUNAR ORBITER LUNA 10. Dolginov, Sh. Sh.; Eroshenko, E. G.; Zhuzgov, L. N.; Zhulin, I. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 352-6(1967).

Translated from Geomagn. Aeron., 7: 436-41(1967).

The nature of the near-lunar field and the possibility of detecting the geomagnetic tail are discussed in relation to the results of magnetic and plasma measurements by Luna 10 in the vicinity of the moon. (auth)

34428 THEORY OF HYDROMAGNETIC SOUNDING OF PLASMA CONCENTRATION IN THE EXOSPHERE. Gul'el'mi, A. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 357-63(1967).

Translated from Geomagn. Aeron., 7: 442-50(1967).

A theory is developed for diagnosing plasma concentration at great heights by the method of hydromagnetic sounding. The problem of diagnosis is treated as the inverse Sturm–Liouville problem for torsional vibrations of the magnetosphere. The problem is reduced in the approximation of geometrical optics to the solution of an Abelian integral equation. A formula is obtained permitting computation of the equatorial concentration profile from the lattitude dependence of the periods of torsional vibrations. Specific concentration profiles are constructed. (auth)

34429 RELATIONS BETWEEN BURSTS OF ENERGETIC ELECTRONS AT 17 EARTH RADII IN THE MAGNETOTAIL AND RADIO ABSORPTION EVENTS IN THE IONOSPHERIC D REGION. Hargreaves, J. K. (Environmental Science Services Administration, Boulder, Colo.); Hones, E. W. Jr.; Singer, S. Planet. Space Sci., 16: 567-80(May 1968). (LA-DC-9169).

A three-dimensional picture of the auroral phenomena around the Earth, in terms of their energy relations and movements, may be constructed by combining ground-based synoptic observations with measurements in selected satellite orbits. In the magnetotail at $17R_E$ bursts of energetic electrons ($E > 45$ keV), presumably the high-energy component of clouds of hot plasma, are frequently observed. It is suggested that these plasma clouds appear at successively greater distances from the Earth, so that they appear to be moving away from the Earth into the magnetotail. The flux of electrons in these bursts is less intense than the associated flux at ionospheric heights deduced from D-region absorption. In these and other respects the results suggest that these two phenomena (magnetospheric electron bursts and D-region absorption) have a common source near midnight, perhaps at about $7R_E$ geocentric distance. (auth) (UK)

34430 HYDROMAGNETIC STABILITY OF THE MAGNETOSPHERIC BOUNDARY. Southwood, D. J. (Imperial Coll. of Science and Tech., London). Planet. Space Sci., 16: 587-605 (May 1968).

The hydromagnetic Kelvin–Helmholtz stability problem was studied for an infinite plane interface between compressible infinitely conducting fluids. The critical value of the relative streaming velocity for stability was studied by use of the equations for marginal stability without making the simplifying physical assumptions used by previous authors. In application to the magnetosphere boundary some predictions can be made without too precise a knowledge of all the parameters involved. At middle and low latitudes the first growing modes propagate across the Earth's field with a very low phase velocity and wave fronts closely aligned to meridian planes. The modes tend to exhibit circular polarisation in a plane almost perpendicular to the Earth's field. This behaviour should also occur at high latitudes when the magnetosheath field is closely aligned to the Earth's field. (auth) (UK)

34431 OBSERVATIONS OF TOTAL ELECTRON CONTENT OVER EUROPE, JANUARY 1965. Planet. Space Sci., 16: 607-14 (May 1968).

Faraday fading data taken at six locations in Europe and one in the United States were reduced using common techniques and were used to plot synoptic maps. Values computed were roughly between 1 and 5×10^{16} electrons/m². An attempt was made to estimate errors by comparing results from the same passes seen at different observatories. The results were found consistent within 20% for ⅔ of the satellite passes. (auth) (UK)

34432 BEHAVIOR OF THE TOPSIDE IONOSPHERE DURING A GREAT MAGNETIC STORM. Bauer, S. J.; Krishnamurthy, B. V. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci., 16: 653-63(May 1968).

Variations in the electron density distribution of the topside ionosphere (including the height of the F2 peak) obtained from Alouette I during the great magnetic storm of April 17–19, 1965, were analyzed. Both enhancement and depletion of topside ionization were observed, depending on the phase of the magnetic storm. Specifically, enhancement was associated with the positive phase and the asymmetric part of the main phase, while depletion of the topside ionosphere occurred during the symmetric part of the storm main phase over a latitude range corresponding to L values greater than 3. Associated with this depletion was a redistribution of ionization, indicating that the topside ionosphere during the symmetric main phase consisted primarily of O^+ (with H^+ being depleted). The enhancement of topside ionization during the positive phase of the storm appeared to be associated with the compression of the daytime magnetosphere during that phase of the storm. The depletion appeared to be associated with the expansion of field tubes due to the presence of the high energy density ring current plasma, as observed on satellites, causing an upward flux from the topside ionosphere. A similar upward flux could also arise from a sink of thermal plasma in the magnetosphere due to the local energization of this plasma. (auth) (UK)

34433 TROPOSPHERIC SCATTERING OF TWILIGHT N_2^+ EMISSION. Broadfoot, A. Lyle (Kitt Peak National Observatory, Tucson, Ariz.). Planet. Space Sci., 16: 693-9(May 1968).

Rayleigh scattering by the troposphere is found to have a serious effect on measurements of the 3914 Å band of N_2^+ in the twilight atmosphere. A model of the N_2^+ emission is constructed for the whole twilight atmosphere. Numerical integration of the sky brightness tables of Coulson, Dane, and Sekera (1960) gives an almost exact treatment of scattered light. The twilight observations are reproduced satisfactorily by including this effect. Thus, photoionization is sufficient to explain the abundance of N_2^+ in the twilight. (auth)

34434 INTERFEROMETRIC MEASUREMENTS OF λ 5577 A EMISSION TEMPERATURES IN AURORA. Karandikar, R. V. (Osmania Univ., Hyderabad, India. Air Force Cambridge Research Labs., Bedford, Mass.). Planet. Space Sci., 16: 539-56 (May 1968).

Observations of the λ5577 Å [OI] line profiles in aurorae made with a photoelectric pressure scanning Fabry–Perot interferometer at Fort Churchill, Canada, located near the auroral zone maximum, are described. The deduced Doppler temperatures for faint diffuse glows yielded values in the range 170 to 690°K, with about 80% of the values lying in the range 200 to 400°K. Temperatures for sub-visual aurora were found to be in the general range 400 to 700°K, which suggests that this auroral form is a distinct type originating at higher altitudes. A large number of observations during one night showed no definite trend of nocturnal variations of auroral temperatures. (auth) (UK)

34435 APPARENT ROTATION OF THE UPPER ATMOSPHERE. Challinor, R. A. (CSIRO, Camden, Australia). Planet. Space Sci., 16: 557-66(May 1968).

The F-region winds expected from ion motion and neutral air pressure gradients are computed and reconciled with the belief, based on satellite observations, that the upper atmosphere rotates faster than the Earth. It is pointed out that the satellite observations refer to wind momentum flux rather than speed, and are weighted to low latitudes and daytime. Eastward winds are expected; maximum eastward winds are predicted in the early evening, in agreement with satellite findings. But the predicted global wind pattern is not eastward. During the day, when ion densities are great, electrodynamic drag between the ions and neutral molecules is important. Under these conditions, a strong eastward wind is expected near the equator, where ion velocities are greatest. At night, however, when electrodynamic drag is weak, there is no corresponding equatorial westward wind and pressure gradients take control at all latitudes. These cause a strong equatorward wind near midnight, which could have the same effect on a satellite orbit as a weaker eastward wind. (auth) (UK)

34436 SIMULTANEOUS GROUND AND SATELLITE RECORDINGS AT HIGH LATITUDES OF THE ENHANCED ELECTROMAGNETIC BAND EMISSION BETWEEN 500 AND 1000 Hz. Egeland, A.; Holtet, J. (Univ. of Oslo). Nature (London), 218: 935-7 (June 8, 1968).

Three dominant electromagnetic emission bands, centered at about 300, 700, and 1,600 Hz are often observed in the range 100 to 2,000 Hz. The studies described apply to a limited part of this range. Most of the observations were made at Lavangsdalen, Norway (70°N), a site chosen because of the very low background of man-made noise. Frequency and intensity as a function of time were determined by sonograph, and accurate spectral density functions were computer calculated. An example of a power spectrum so obtained is shown and a brief summary given of the main characteristics of the 700 Hz band as observed on the ground. The satellite recordings were made with Alouette II, at an altitude of ~2,000 km. It was found that in every case when enhanced 700-Hz emissions were satellite recorded it was possible to find radiation in the same frequency band on the ground; the frequency of peak power was also very nearly the same at 2,000 km as at ground; the half-intensity bandwidth was usually somewhat larger at satellite altitudes than at ground; and the fine structure of the band appeared very similar on ground and satellite records. (UK)

34437 ANOMALOUS LUNI–SOLAR DAILY VARIATION IN THE GEOMAGNETIC FIELD AT WATHEROO, WESTERN AUSTRALIA. Malin, S. R. C.; Winch, D. E. (Royal Greenwich Observatory, Hailsham, Eng.). Nature (London), 218: 941-2(June 8, 1968).

A program for the analysis of IGY data from magnetic observatories was extended to the above observatory. The data consisted of alternate mean hourly values of declination ($\underline{D}$), horizontal component ($\underline{H}$), and vertically downward component ($\underline{Z}$), of the geomagnetic field. The object of the analysis was the calculation of l_n and λ_n, the amplitude and phase of the luni-solar daily harmonic $\underline{L}_n$. Results are tabulated. The $\underline{D}$ and $\underline{H}$ results were normal for latitude. An exceptional feature was the large amplitude of $\underline{L}_2(\underline{Z})$ for southern summer months and the seasonal variation in $\underline{Z}$. ($\underline{L}_2$ represents the semi-diurnal lunar tide, which is usually the dominant harmonic). For most observatories the luni-solar variations in $\underline{Z}$ are smaller than those in $\underline{H}$ and $\underline{D}$, but for Watheroo the variations in $\underline{Z}$ were greater. The summer value of $\underline{l}_2(\underline{Z})$ was greater than for any element at any observatory except $\underline{l}_2(\underline{H})$ at observatories under the equatorial electrojet. During the IGY, sunspot activity was at a very high level, and a number of analyses indicated that $\underline{l}_2(\underline{Z})$ increases with solar activity. Estimates of the ratio of $\underline{l}_2(\underline{Z})$ for sunspot maximum to minimum vary from 1.0 to 1.9, but even if the value of 1.9 was applicable to Watheroo the mean value of $\underline{l}_2(\underline{Z})$, summer, would still represent the greatest $\underline{Z}$ value yet determined. There was also an anomalously large solar diurnal variation in $\underline{Z}$ at Watheroo. It is concluded that Watheroo lies near a region of anomalous conductivity below the surface, which modifies the geomagnetic effect of the overhead current system. (UK)

34438 EXPERIMENTAL EVIDENCE OF SHORT-PERIOD OSCILLATIONS OF IONOSPHERIC WINDS. Revah, Isaac; Spizzichino, Andre (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France. Groupe de Recherches ionospheriques, Issy-les-Moulineaux, France). Compt. Rend., Ser. A and B, 266: 887-9(Mar. 25, 1968). (In French).

It is shown that the structure of the winds between 89 and 110 km of altitude is characterized by waves having different periods and phase velocities tending toward low values. (tr-auth)

34439 CHARACTERISTICS OF PLASMA LINES OBSERVED IN FRANCE BY A PROBE WITH THOMSON SCATTERING. Carru, Henri; Lejeune, Gerard (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Compt. Rend., Ser. A and B, 266: 890-2(Mar. 25, 1968). (In French).

A modification of the Thomson scattering probe equipment of the C.N.E.T. has permitted the experimental detection of some characteristics of the plasma lines in the F region. An application of the excitation theory of these lines by photoelectrons shows that, in some cases, the influence of electron–ion collisions is not negligible. The theoretical and experimental values are in agreement, taking into account the precision of their determination. (tr-auth)

34440 FORMATION OF THE IONIZATION TROUGH OF THE F2 LAYER AND THERMAL EFFECT OF PHOTOELECTRONS AT THE MAGNETIC EQUATOR. Vila, Paul (CNRS–CNET, Issy-les-Moulineaux, France). Compt. Rend., Ser. A and B, 266: 748-50(Mar. 11, 1968). (In French).

The ionization trough of the F2 layer at the magnetic equator is described. The phenomenon requires a particular mechanism at the magnetic equator capable of maintaining, between 05.45 and 07.00 TL, a superheated zone around 400 km and then of letting it descend rapidly to 240 km where a weak electron temperature maximum is stabilized toward 09.00 TL. The mechanism satisfying these conditions is the heating of the electron gas of the apical portions of the tubes of force by the nonlocal photoelectron flux produced in the two lower portions of the tube intersected by decreasing levels of production. (J.S.R.)

34441 PRINCIPLES OF THE THEORY OF THE EARTH'S HYDROMAGNETIC DYNAMO. Braginskii, S. A. Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 323-9(1967).

Translated from Geomagn. Aeron., 7: 401-10(1967).

Various hypotheses on the nature of terrestrial magnetism are examined. Kinematic models of the geomagnetic dynamo, particularly those based on the use of "generation equations," are analyzed. The possibility of explaining the main geomagnetic facts proceeding from the theory of the hydromagnetic dynamo is discussed. For this purpose it is necessary to develop a more complete theory, which is not limited to the kinematic approach, but also takes into account the "motor" of the Earth's "dynamo machine." The problems of the geomagnetic field theory are examined and the difficulties in developing such a theory are discussed. (auth)

34442 INFLUENCE OF AN ELECTRIC FIELD ON THE MOTION OF CHARGED PARTICLES IN AN INHOMOGENEOUS MAGNETIC FIELD. Samokhin, M. V. (Inst. of Radio Engineering, Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 330-4(1967).

Translated from Geomagn. Aeron., 7: 411-16(1967).

The two-dimensional motion of charged particles in a magnetic field whose intensity varies as $B_0 + a/r^3$ (where B_0 and a are constants and r is the distance from the origin of coordinates) is examined. It is assumed that the electric field is perpendicular to the magnetic field and allowance is made for charge separation produced by the inertia of ions. It is shown that the Poisson equation permits an analytical solution represented by a combination of hypergeometric functions, and the dimensionless parameter, characterizing the problem, is found. The dependence of the magnitude of the forbidden zone on particle energy as superthermal particles travel in the electric field produced by thermal particles is examined. (auth)

34443 BOUNDARY OF THE OUTER RADIATION BELT AND ZONE OF UNSTABLE RADIATION. Vernov, S. N.; Vakulov, P. V.; Kuznetsov, S. N.; Logachev, Yu. I.; Sosnovets, E. N.; Stolpovskii, V. G. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 335-9(1967).

Translated from Geomagn. Aeron., 7: 417-22(1967).

The position of the outer radiation belt boundary at latitudes 25 to 50° and the location and properties of the zone of unstable radiation beyond the outer radiation belt are examined. The position of the outer radiation belt boundary and the shape of the unstable radiation zone depend strongly on local time. The intensity of electrons with $E \gtrsim 100$ keV in the zone of unstable radiation depends on magnetic activity. The correlation coefficient between log N and K_p reaches 77%. A study of the relationship between log N and the Q index showed that magnetic activity increases one hour before intensity increases in the unstable radiation zone. The assumption is made that particles of the unstable radiation zone are generated in the magnetosphere tail in the vicinity of the neutral line. (auth)

34444 GEOMAGNETIC EFFECT IN VERTICAL DISPLACEMENTS OF IONIZATION IN THE F REGION OF THE IONOSPHERE. Vasil'ev, K. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 378-81(1967).

Translated from Geomagn. Aeron., 7: 469-74(1967).

The vertical displacements of ionization in the F region are examined on the basis of observations at low latitudes on the schooner Zarya. The distribution of apparent velocities is shown as a function of geomagnetic latitude. A geomagnetic effect is found in the vertical ionization displacements. (auth)

34445 ORIGIN OF LONG-PERIOD MICROPULSATIONS. Patel, V. L. (Univ. of Denver). Nature (London), 218: 857-8 (June 1, 1968).

The origin of micropulsations in the geomagnetic field with periods of several minutes is discussed. After discovery of the magnetospheric tail, ideas on the origin have been extended to include the effect of the tail, and it was suggested that the definite and regular shape of the tail will allow hydromagnetic waves of only certain discrete frequencies to propagate, which may appear as micropulsations. A simple double-cylinder waveguide model of the tail, and a model of theta geometry, are discussed in this connection. It is noted that the magnetospheric tail may occasionally become a cylindrical hydromagnetic resonator, which could explain observed periods of >30 min. (UK)

34446 THE SUNSPOT DEPENDENCE OF L. Fanselau, Gerhard (Geomagnetisches Institut, Potsdam, Ger.). Beitr. Geophys., 77: 75-81(1968). (In German).

Investigation of the fine structure of Sq makes it possible to study lunar variation as well. Hourly lunar phases were used. The mean of all 24 phases produced the well-known half-daily period. Mean deviations decrease, if not the phases themselves; overlapping mean phases, such as means of three phases, are actually used. Correlation of amplitudes with sunspots is obvious. On days with very small R, lunar variation is not clearly noted, since it is near the level of statistical noise. For each phase 25 collective partners were used, giving 75 for the mean phase; the value of 25 is small in comparison to data accumulated by other authors; physically significant results can thus be obtained with smaller amounts of data per phase. The influence of irregular variations is considerable. (BBB)

34447 THE REGISTRATION OF GEOMAGNETIC EAST–WEST COMPONENTS AND THEIR SIGNIFICANCE FOR SSC MORPHOLOGY. Fanselau, Gerhard; Grafe, Armin (Geomagnetisches Institut, Potsdam, Ger.). Beitr. Geophys., 77: 82-6(1968). (In German).

The first recording results of the variometer installed at the Niemegk Observatory in 1965 for registration of the geomagnetic east–west component are described, particularly with respect to the ionospheric sudden storm commencements (ssc's). The ssc in the η component is clearly developed in an illustration; in this case the D_{st} component is not important since at greater amplitudes of H the ssc amplitudes in the D and η components are not appreciably different. One can distinguish morphological choices for the ssc on the basis of the η component. All ssc's with only one direction of impulse may possess no η component, but the approaching sunspot maximum must be reflected. In the absence of ssc's but only pulsations in the η component, the pulsations must have a secondary cause. (BBB)

34448 EVIDENCE OF A 26-MONTH WIND OSCILLATION IN THE LOWER IONOSPHERE OVER CENTRAL EUROPE. **Sprenger, K.; Schminder, R.** (Observatorium fuer Ionosphaerenforschung, Kuhlungsborn, Ger.). **Z. Meteorol., 19: 168-70(1967).**

Results of 8 years of ionospheric drift measurements in the low-frequency range, at a height of 95 km, were examined from the point of view of the 26-month oscillation. This oscillation, as yet only known in the stratosphere, probably exists also in the lower ionosphere and at temperate latitudes it apparently obeys the same phase law as in the stratosphere. Diverse series of monthly means of the zonal component of ionospheric drift, measured at a fixed time of day (20.30 to 21.30 UT), were subjected to harmonic analysis with a period of 26 months. The outstanding feature of drifts in the lower ionosphere is a semi-annual variation of the zonal component, being directed towards the East in winter and summer and towards the West in spring and autumn. The amplitude of the wind oscillation is, on an average, about 3.5 m/sec, and its phase is so that maxima towards the East occurred approximately during July of 1958, September of 1960, November of 1962, and January of 1965. Thus the amplitude seems to be nearly of the same order of magnitude as in the stratosphere. (BBB)

34449 IONOSPHERE REPORT. **Burkard, O.** (Ionosphaerenstation Graz). **Wetter Leben, 19: 296(1967). (In German).**

The report for June and July 1967 is given. In June the state of the ionosphere was labile. Critical frequencies of the F2 layer lay within a scattering region of 4 MHz in the late mornings. The highest frequency was noted on 25 June, with low values on 6, 12, 18, and 27 June. The F1 layer clearly appeared, as did the evening second maximum of the critical frequency of the F2 layer. The sporadic-E layer was more pronounced than in previous months. In July the ionosphere was more quiet. The critical frequency of the F2 layer lay at noon between 5.9 MHz to 8.6 MHz with a mean value of 7.2 MHz. The absolute maximum for a daily run was as usual at 7 pm. The F layer was almost always split. The sporadic-E layer showed slightly increased intensity. On three days (1, 15, 18 July) frequencies over 7 MHz could be recorded at 8 pm. (BBB)

34450 STUDIES OF VARIATIONS IN IONOSPHERIC ABSORPTION DURING THE ECLIPSE OF NOVEMBER 12, 1966. **Tizeira, Hector. Telecommun. J., 34: 386-8(Oct. 1967).**

Measurement of ionospheric ionization during the total eclipse (in South America) of 12 November 1966 is reported. The Argentine Air Force made measurements of ionospheric absorption to permit a thorough study of the D layer on the day of the eclipse and during the two weeks prior and afterwards throughout all the areas of Argentine territory in the zone of total eclipse. These areas were divided into two sectors—active and passive; in the latter, absolute radio silence was ensured to avoid interfering with the measurements and recordings. The vertical incidence method was used by the ionospheric station of the Argentine Navy at Resistencia, which is situated in the zone of total eclipse. The Air Force set up two riometers at San Luis del Palmar, within the zone of total eclipse; they were in operation from 28 October to 27 November on 22 McPs and 50 McPs. The Air Force applied the oblique incidence method by installing three 500-W transmitters in the city of Formosa which emitted radio (CW) signals continuously; equipment to record the field strengths received was installed at Goya, 330 km away. The reflection midpoint was inside the zone of total eclipse. An ion recombination coefficient was obtained. When the recombination is known it will be possible to build models of the profiles of electron density throughout the duration of the eclipse. With the values found in the electron density profiles, it will be possible to determine quantitatively the contribution of the D layer to the absorption of radio waves from space. (BBB)

34451 CCIR ATLAS OF IONOSPHERIC CHARACTERISTICS (CCIR REPORT 340). **Joachim, M. Telecommun. J., 34: 397-400(Oct. 1967).**

In accordance with a decision of the Xth Plenary Assembly, Geneva, 1963, a World Atlas of ionospheric characteristics was prepared and approved in 1966 by the XIth Plenary Assembly, in Oslo. This Atlas, which has become CCIR Report 340, will shortly be published in the form of numerical tables and maps. It already exists in the form of punched cards for use by electronic computers of adequate capacity for this purpose. The purpose of the Atlas is to present a standard compendium of some basic ionospheric parameters determining ionospheric radio propagation. This Atlas must be regarded as provisional. Further improved editions may be issued as future progress is made in the understanding of ionospheric physics and the mechanisms of ionospheric radio propagation. In its version in the form of a set of punched cards, the Atlas contains coefficient cards of the numerical mapping functions of the ionospheric parameters. These cards are used with punched cards containing programs for computing the functions. This form is recommended for use by international organizations, and by others who require the solution of various ionospheric radio propagation problems, or who have a large amount of routine, repetitive computations requiring the information in the Atlas. The F2-layer parameters occupy a major part of this volume, partly because it is generally recognized that the F2-layer is of primary importance in determining long distance high-frequency radio propagation. Nomograms and charts of the solar zenith angle are included for determining parameters for the regular E layer. Information on sporadic-E or F1-layer parameters may be added in future editions. (BBB)

34452 ROCKET PROBE MEASUREMENT OF ELECTRON ENERGY SPECTRA IN THE EARTH'S RADIATION BELTS. **Robb, Donald Stuart. Albuquerque, N. Mex., Univ. of New Mexico, 1967. 95p.**

Thesis.

A highly directional electron spectrometer using silicon semiconductor particle detectors in a multiple coincidence system was developed for the investigation of electron energy spectra in the Earth's radiation belts. The spectrometer responded to electrons in the energy range from .1 to 5 MeV and discriminated against protons with energies in excess of .5 MeV. Details of instrument construction and electronic circuit diagrams are given. The instrument was used on a rocket probe whose trajectory traversed the inner belt and a portion of the outer belt in June 1965. Details of probe instrumentation are summarized, and data obtained from the electron spectrometer are presented. (Diss. Abstr.)

34453 X-RAY AND EUV PHOTOMETRIC DETERMINATIONS OF THE LATITUDINAL AND TEMPORAL VARIATIONS OF THE TOTAL PARTICLE AND O_2 MOLECULE DENSITY DISTRIBUTION IN THE REGION 70-150 KILOMETERS IN THE EARTH'S ATMOSPHERE. **Grobecker, Alan John. Los Angeles, Univ. of California, 1967. 194p.**

Thesis.

On February 21, 1966, three experiments prepared by the E. O. Hulburt Center for Space Research of NRL were rocket-launched: two at Eglin Gulf Test Range, Florida (30°12'N 86°42'W), and one at Churchill Research Range, Canada (58°45'N 93°00'W). The three experiments constitute an investigation of latitudinal and temporal variation of the O_2 and total-particle density in the terrestrial atmosphere between 70- and 150-km altitude. For each launch, data were obtained on absorption of solar radiation in the Schumann–Runge continuum, hydrogen Lyman alpha, and x rays in the 44- to 60-Å and 0- to 20-Å bands. From these data, densities of total particles, O_2 molecules, and atomic oxygen were computed. Distribution of the density versus altitude is shown in each case. Total fluxes, outside the atmosphere, of the solar-ultraviolet and x-ray bands were compared with solar fluxes in similar x-ray bands simultaneously measured by the NRL Solar Monitoring Satellite (1965-93A). Electron density data derived by ionosonde at each launch location are also given. (TSS) (Diss. Abstr.)

34454 PATTERNS OF OCCURRENCE AND SPATIAL CHARACTERISTICS OF E_s. Ovezgel'dyyev, O. (Inst. of Terrestrial Physics and the Atmosphere, Ashkhabad, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 683-7(1967).

Translated from Geomagn. Aeron., 7: 841-6(1967).

The results of investigations of the diurnal and seasonal patterns of E_s occurrence and their latitudinal variations are reported along with the results of studies on the local E_s characteristics. It is shown that the patterns of E_s occurrence differ significantly in the equatorial, middle-latitude, and high-latitude zones. (auth)

34455 COMPUTATIONS OF THE SHAPES OF ATMOSPHERICS. **Fligel', D. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 688-93(1967).**

Translated from Geomagn. Aeron., 7: 847-53(1967).

Results are reported of computations of the shapes of atmospherics at distances from 50 to 15,000 km from the source, using both a plane and a spherical wave-guide model without allowance for the influence of the geomagnetic field. The results obtained are compared with experimental data. (auth)

34456 ORIGIN OF SMALL-SCALE INHOMOGENEITIES ASSOCIATED WITH THE ELECTRIC CURRENT IN THE EQUATORIAL JET. **Kamenetskaya, G. Kh. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 676-82(1967).**

Translated from Geomagn. Aeron., 7: 833-40(1967).

The quasi-hydrodynamic method was used to analyze Cherenkov excitation of electrostatic waves by the electric current of the equatorial jet perpendicular to the external magnetic field. It was found that this instability is of the convective type and occurs when the direction of electron velocity in the current jet is somewhat greater than the thermal velocity of ions. The dependence of the increments and phase velocities of developing waves on the parameters of the current jet was determined. (auth)

34457 CORRELATION OF THE RECIPROCITY PRINCIPLE IN THE REFLECTION OF ULTRALONG RADIO WAVES FROM THE IONOSPHERE. Baybulatov, R. B. (Computation Center, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 739-40 (1967).

Translated from Geomagn. Aeron., 7: 906-7(1967).

This paper gives the dependences of the reflection coefficient R on ω and θ for electron concentration profiles close to real ones both with and without consideration of the C layer. The calculations were made for the case of propagation of ulw along the geomagnetic equator, where only the horizontal component $H\varphi$ of the Earth's magnetic field is different from zero. (W.D.M.)

34458 RELATION BETWEEN THE DRIFT INHOMOGENEITIES IN THE UPPER IONOSPHERE AND DIURNAL VARIATIONS OF THE EARTH'S MAGNETIC FIELD. Zelenkov, V. E.; Rudneva, N. M. (Inst of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 737-8(1967).

Translated from Geomagn. Aeron., 7: 904-5(1967).

The present paper compares the diurnal variations of the magnetic field at Alma-Ata with diurnal drifts of ionization inhomogeneities at heights above 250 to 270 km. During the period under consideration, 13,894 measurements were performed. Of these, 6750 were selected for the analysis. (W.D.M.)

34459 RELATIONSHIP BETWEEN E_s AND THE ELECTRON CONCENTRATION IN THE SURROUNDING MEDIUM. Starovatov, A. A. (Ionosphere Sector, Kazakh, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 736(1967).

Translated from Geomagn. Aeron., 7: 903(1967).

An attempt was made to find the correlation between f_fE_s and the electron concentration at the level where the E_s layer is located. The data, from Alma-Ata, pertain to five hours around midday on Regular International Days. (W.D.M.)

34460 E_s IN THE SUBAURORAL ZONE BASED ON OBSERVATIONS IN YAKUTSK. Mamrukov, A. P. (Inst. of Cosmic Physics, Investigations, and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 734-6(1967).

Translated from Geomagn. Aeron., 7: 902(1967).

The temporal characteristics of the appearance of E_s over Yakutsk for each type individually was examined, based on 15-min observations for 1958–1965. The results obtained made it possible to divide the types of E_s observed into three groups, based on the similarity of the form of the temporal changes in PE_s, t_r, and f_0E_s of the different types of E_s. Based on the form of the temporal changes (diurnal, seasonal, and cyclic variations) of the indicated characteristics of each group of E_s and their comparison with the temporal changes of other geophysical phenomena, an hypothesis can be advanced concerning the possible nature of the agent responsible for the formation of each group of E_s. (W.D.M.)

34461 COMPUTATION OF THE NIGHTTIME F REGION IONIZATION IN THE PRESENCE OF E_s. Chernysheva, S. P.; Ryss, I. K.; Dubkina, V. P. (Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 731-3(1967).

Translated from Geomagn. Aeron., 7: 899-900(1967).

N(z) profiles were computed using the method of Davilkin and Zhuchenko (1964), which is based on the integral method of Titheridge with allowance for the influence of the geomagnetic field. The sets of coefficients necessary for conversion from virtual to true heights were computed for Rostov on a Minsk-12 computer for several fixed frequencies, from 0.1 to 9.5 MHz. (W.D.M.)

34462 VARIATIONS OF THE IONIZATION RATE, q(h), IN THE F_2-LAYER AT HIGH LATITUDES DURING SOLAR ACTIVITY MAXIMUM. Kolomiytsev, O. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 729-31(1967).

Translated from Geomagn. Aeron., 7: 896-8(1967).

The ionization rate, q, for the F2 layer was computed from the results of vertical ionospheric soundings at Vostok Station, using a method described (Geomagn. Aeron., 7: 731(1967)) and the COSPAR International Reference Atmosphere 1965 model of the atmosphere. The results of an analysis of the diurnal and seasonal variations of q(h) during solar activity maximum are presented. (W.D.M.)

34463 HEIGHTS OF THE NIGHTTIME F REGION DURING INTENSE MAGNETIC–IONOSPHERIC STORMS IN THE IGY AND IQSY. Shapiro, B. S.; Shashun'kina, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 727-9 (1967).

Translated from Geomagn. Aeron., 7: 894-5(1967).

The heights of the maximum of the nighttime F region over Moscow during the active periods of 48 storms with a sudden commencement were studied in years of very high (1957–1959) and very low (1964–1965) solar activity. The hourly h_p values ($h_p \approx h_{max}$) were used as initial data. (W.D.M.)

34464 SPREAD-F AND MAGNETIC ACTIVITY. Mizun, Yu. G. (Polar Geophysical Inst., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 726-7(1967).

Translated from Geomagn. Aeron., 7: 893(1967).

The formation of inhomogeneities producing spread-F is directly associated with the effectiveness of the transfer of ionization from the equator to the subtropics. The spread of reflections must increase during the initial phase of a storm and decrease during the main phase. The validity of this assumption was investigated on the basis of data from vertical sounding stations in 1957–1959, located in the vicinity of the equator: Madras, Tiruchirapalli, Koddikanol, Trivandrum, Talara, Chacaltaya, and Huancayo. Storms were selected whose initial phase occurred at night local time. Some of the f_0F2 graphs obtained are given. (W.D.M.)

34465 THREE-DIMENSIONAL HYDROMAGNETIC DISTURBANCES IN A COLD PLASMA. Van'yan, L. L.; Dmitriev, V. I. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 722-4(1967).

Translated from Geomagn. Aeron., 7: 888-90(1967).

A point source of hydromagnetic disturbances in a homogeneous cold plasma with a homogeneous vertical magnetic field is examined. The absorption of energy is neglected and it is assumed that the oscillation frequencies are small compared with the gyrofrequency of ions. (W.D.M.)

34466 THREE-DIMENSIONAL DISTURBANCES IN A COLD PLASMA. Van'yan, L. L.; Dmitriev, V. I. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 720-1(1967).

Translated from Geomagn. Aeron., 7: 887(1967).

An expression is obtained which coincides with the vector potential of a magnetic dipole in an isotropic dielectric, indicating that the nature of the waves is purely magnetoacoustic. (W.D.M.)

34467 EFFECTS OF THE SUPERPOSITION OF TWO ANOMALOUS X-RAY EMISSIONS IN THE MIDDLE IONOSPHERE. Krivsky, L.; Serafimov, K. (Astronomical Inst., Ondjejov, Czechoslovakia. Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 673-5(1967).

Translated from Geomagn. Aeron., 7: 829-32(1967).

Ionospheric effects recorded at 100 to 150 km in inospheric soundings at Sofia on December 29, 1965, during the superposition of two qualitatively different x-ray emissions produced by solar flares on the Sun were analyzed. The results are compared with measurements of x-ray emission in various ranges of Explorer 30. (auth)

34468 RESULTS OF IONOSPHERIC OBSERVATIONS AT THE MAGNETICALLY CONJUGATE POINTS KERGUELEN–SOGRA. Ben'kova, N. P.; Bukin, G. V.; Davoust, K.; Kerblai, T. S.; Lafeille, M.; Taieb, Sh.; Fainot, G. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow. Centre National des Etudes de Telecommunication, Paris). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 663-9(1967).

Translated from Geomagn. Aeron., 7: 815-24(1967).

The variations of ionospheric parameters in two magnetically conjugate regions, Kerguelen and Sogra, from September to October 1965 are analyzed. A comparison of median diurnal f_0F_2 patterns showed that the ionization level is approximately the same at the two stations during the equinox; the maximum of the diurnal patterns is reduced to the same universal time. During ionospheric storms, both stations showed some features of high-latitude stations (the appearance of an E_s of the r-type, etc.). Disturbance during storms was considerably more intense at Kerguelen than at Sogra. (auth)

34469 SOME ANALOGIES BETWEEN CORPUSCULAR AND WAVE RADIATION IN THEIR EFFECT ON THE IONOSPHERE.

Velinov, P. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 670-2(1967).

Translated from Geomagn. Aeron., 7: 825-8(1967).

Some aspects of the effect of wave and corpuscular radiation on the ionosphere are examined. (auth)

34470 DEPENDENCE OF GEOMAGNETIC ACTIVITY ON THE ENERGY DENSITY AND PRESSURE OF THE INTERPLANETARY PLASMA AND ON THE MAGNETIC FIELD. Kovalevskii, I. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 712-13(1967).

Translated from Geomagn. Aeron., 7: 878-9(1967).

Graphs of the dependence of 3-hr $\bar{K}_p$ values, averaged for the respective sectors, on the average 3-hour ϵ_1, ϵ_2, ϵ_3, or p_1, p_2, and p_3 values were plotted on the basis of previous data. An analysis of the data shows that there is no well-defined dependence in the $\bar{K}_p + (\epsilon_1, p_1)$ and $\bar{K}_p - (\epsilon_1, p_1)$ graphs, although the $\bar{K}_p$ or $\bar{a}_p$ values are higher when $p_1 = 16 \times 10^{-9}$ dyne cm^{-2}. (W.D.M.)

34471 IMPROVEMENT OF THE ANALYTICAL REPRESENTATION OF SECULAR VARIATION. Bazarzhapov, A. D.; Kolomiytseva, G. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 704-9(1967).

Translated from Geomagn. Aeron., 7: 868-75(1967).

A new method of computing spherical harmonic coefficients as applied to secular geomagnetic field variations is described. Computations performed on a test chart for a very uneven global network of magnetic observatories show the great advantages of this method over the ordinary method. (auth)

34472 WESTWARD DRIFT OF THE GEOMAGNETIC FIELD AND DISPLACEMENT OF ECCENTRIC DIPOLES. Lyakhov, B. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 757-9(1967).

Translated from Geomagn. Aeron., 7: 926-7(1967).

If the principal magnetic field of the Earth is represented by three eccentric dipoles, the westward drift may be explained as a displacement of the dipoles, i.e., displacement of eddy motions on the surface of the Earth's core. If the concept that the principal terrestrial magnetic field consists of a sum of fields of three eccentric dipoles is adopted, then for a given combination of dipoles, one can explain the relatively sharp transition of the magnetic equator from the southern to the northern hemisphere in the Atlantic Ocean. (W.D.M.)

34473 CAUSES OF THE SO-CALLED WESTWARD DRIFT OF THE GEOMAGNETIC FIELD. Pudovkin, I. M.; Valueva, G. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 754-7(1967).

Translated from Geomagn. Aeron., 7: 923-5(1967).

It is concluded that the period of rotation of the geomagnetic field is 1200 years. Periods obtained are compared with data of archeomagnetic studies and the work of Macht (Trans. Amer. Geophys. Union, 32: 555(1951)). (W.D.M.)

34474 OPTIMUM REPRESENTATION OF THE GEOMAGNETIC FIELD BY THREE DIPOLES. Kropachev, E. P.; Kolesova, V. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 753-4(1967).

Translated from Geomagn. Aeron., 7: 921-2(1967).

It is felt that two dipoles are insufficient for describing the main geomagnetic field. From the morphology of the field (two maxima and one minimum with an intensity of the same order) it is apparent that three variants of the three-dipole model are possible: (a) one source with a magnetic moment approximately equal to the moment of an eccentric dipole and two sources with much smaller moments, (b) two sources with moments of approximately the same order and one with a small moment, and (c) three sources with moments of the same order. The iterative method was used to obtain solutions for a and b. (W.D.M.)

34475 STATISTICAL STUDY OF THE DEPENDENCE OF THE AMPLITUDE OF TYPE Pc STABLE PULSATIONS ON THE PHASE OF THE MOON. Shchepetnov, R. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 751-2(1967).

Translated from Geomagn. Aeron., 7: 919-20(1967).

In determinations of the contribution of the Moon to the geomagnetic activity by statistical methods, contradictory conclusions have been reached. Most authors use the K_p index. Apparently in such studies, the K_p index is too rough a measure of the activity, since it includes various effects, while the sensitivity of the starting data is low. In the present paper, the daily PcE index was used. The PcE index determines the variation of the amplitude of short-period oscillations of type Pc in time and is independent of the level of the field at a given station. In this case, the PcE index more unambiguously reflects the properties of an external source for a sensitivity of the initial data one order of magnitude or higher than the initial data for K_p. (W.D.M.)

34476 MAGNETIC ACTIVITY AT HIGH LATITUDES OF THE NORTHERN HEMISPHERE DURING THE IQSY. Afonina, R. G.; Fel'dshteyn, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 748-51(1967).

Translated from Geomagn. Aeron., 7: 916-18(1967).

In an analysis of the distribution of K indices during the period of the IQSY, use was made of results of observations of the same observatories as for the period of the IGY. The calculation of S_a from mean diurnal values of K indices in equivalent amplitudes ($\bar{F}K^{\gamma}$) was carried out for winter and summer 1964 for all the days and separately for $K_p \leq 1$, $K_p = 3$, and $K_p = 5$. (W.D.M.)

34477 DEPENDENCE OF THE BOUNDARY OF THE MAGNETOSPHERE ON THE NONDIPOLE PART OF THE GEOMAGNETIC FIELD. Rudneva, N. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 747-8(1967).

Translated from Geomagn. Aeron., 7: 915(1967).

The effect of the nondipole portion of the geomagnetic field on the boundary of the magnetosphere is difficult to determine because of the low accuracy of the measurements and calculations. The purpose of the present work was to study the dependence of the distance from the center of the Earth to the boundary of the magnetosphere on geographical and geomagnetic coordinates based on data of magnetic observations of Explorer 12. (W.D.M.)

34478 IONOSPHERIC EFFECTS ASSOCIATED WITH THE APPEARANCE OF ENERGETIC ELECTRONS IN THE TAIL OF THE MAGNETOSPHERE. Driatskii, V. M. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 724-6(1967).

Translated from Geomagn. Aeron., 7: 891-2(1967).

A case of the relationship between ionospheric effects and the appearance of energetic electrons on the night side of the magnetosphere was described by Reid and Parthasarthy (J. Geophys. Res., 71: 3267(1966)). Auroral absorption, recorded by the riometer at 22-10h UT on May 28, 1964, at the South Pole station, agreed very closely in time with a burst of electrons with E > 45 keV, recorded by IMP-1. Riometers in the auroral zone did not detect absorption in this case. An attempt was made to verify whether any unusual effects were observed at Soviet Arctic and Antarctic stations. (W.D.M.)

34479 SOME RESULTS OF STUDIES OF MICROPULSATIONS OF THE Pi1 TYPE AT MAGNETICALLY CONJUGATE POINTS. Raspopov, O. S.; Troitskaya, V. A.; Gendrin, R.; Kazak, B. N.; Loran, D. (Leningrad State Univ. National Center of Radio Communications Research, Paris). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 701-3(1967).

Translated from Geomagn. Aeron., 7: 864-7(1967).

"Bursts" of Pi1 at the magnetically conjugate points Sogra and Kerguelen were analyzed. The results of the analysis testify to the difference in the spectra and amplitudes of micropulsations of this type at magnetically conjugate points, which agrees with the theory of Nishida. (auth)

34480 BEHAVIOR OF GEOMAGNETIC FIELD PULSATIONS OF THE Pi 2 TYPE AT MAGNETICALLY CONJUGATE POINTS. Raspopov, O. M.; Troitskaya, V. A.; Schlich, R.; Lizunkova, I. S.; Kazak, B. N.; Koshelevskii, V. K. (Leningrad State Univ. Univ., Paris). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 697-700(1967).

Translated from Geomagn. Aeron., 7: 858-63(1967).

An analysis of the behavior of geomagnetic pulsations of the Pi2 type at the magnetically conjugate points Sogra and Kerguelen showed that there is good correspondence between the form, period, and amplitude of Pi2 at conjugate points. The sign of the H components coincides and that of the D components differs in the Northern and Southern Hemispheres. (auth)

34481 RELATIONSHIP BETWEEN MAGNETIC DISTURBANCE IN THE ARCTIC AND SOLAR ACTIVITY. Zhigalova, N. N. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 694-6(1967).

Translated from Geomagn. Aeron., 7: 854-7(1967).

The relationship between magnetic activity and the sunspot number was examined for each hour of the day separately by seasons and for solar cycles Nos. 17, 18, and 19. It is shown that the highest positive correlation is observed in summer at time intervals from 6 to 8h, from 10 to 14h, from 16 to 18h, and 20h local geomagnetic time. A high negative correlation is observed at night in winter at Tikhaya, Chelyuskin, and Dixon stations. (auth)

34482 RAPID INTENSITY VARIATIONS OF ENERGETIC ELECTRONS IN THE GEOMAGNETOSPHERE. Tverskaya, L. V.; Tel'tsov, M. V.; Shavrin, P. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 717-19(1967).
Translated from Geomagn. Aeron., 7: 883-5(1967).

The results of measurements on the Molniya 1 satellite of electrons with $E > 40$ keV were reported previously with a description of the equipment and experimental conditions. The equipment permitted study of rapid intensity variations of a duration of less than one second. The present communication contains the preliminary results of a study of the nature of these variations. (W.D.M.)

34483 VARIATIONS OF THE SPECTRUM AND INTENSITY OF ELECTRONS IN THE VICINITY OF THE BOUNDARY OF THE REGION OF TRAPPED RADIATION. Savun, O. I.; Tverskaya, L. V.; Tel'tsov, M. V.; Shavrin, P. N. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 643-6(1967).
Translated from Geomagn. Aeron., 7: 789-93(1967).

The variations in the intensity and spectrum of electrons on the morning and day sides of the magnetosphere in the vicinity of the boundary of the region of trapped radiation were investigated on the basis of measurements on the satellite Molniya-1. (auth)

34484 IMPORTANCE OF THE GENERALIZED RIEMANN PROBLEM TO THE THEORY OF THE INTERACTION OF A SOLAR PLASMA WITH THE GEOMAGNETIC FIELD. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 7: 716-17(1967).
Translated from Geomagn. Aeron., 7: 882(1967).

It is noted that, as a result of the interaction of the solar plasma with the geomagnetic field, one of the possible combinations that could be realized is that where a random discontinuity breaks down into 7 discontinuities: a contact discontinuity coinciding with the magnetosphere boundary; a rapid shock wave; a rotational discontinuity and a slow shock wave propagating in the magnetosphere; a rapid shock wave; a rotational discontinuity; and a slow shock wave propagating in the interplanetary medium. (W.D.M.)

34485 VARIATIONS OF THE IONIZING RADIATION OF THE IONOSPHERIC E LAYER. Serafimov, Kiril (Fizicheski Institut, Sofia). Izv. Sekts. Astron, Bulg. Akad. Nauk., 1: 109-26 (1967). (In Bulgarian).

Analysis is given showing that to eliminate aeronomic effects, it is necessary to take into account the seasonal variations of the ionization index. A method for determining the ionization index is proposed, which foresees the use of f_0E values obtained at all hours of the day, rather than only the midday values. It is shown that for most hours of the day, quasi-stationary conditions and the divergence term may be neglected as far as the ionization neutralizing processes are concerned. It is seen that the ionization-index variations correlate well with the relative variations of solar radiation at 1500 Mc. (IAA)

34486 LATITUDE DEPENDENCE OF NON-STOERMER CUTOFFS FOR CHARGED PARTICLES INVADING QUIET GEOMAGNETIC FIELD. Hakura, Yukio (Radio Research Labs., Tokyo). Rep. Ionosphere Space Res. Jap., 20: No. 1, 60-2(1966).

The latitude dependence of non-Störmer cutoffs obtained from the lowest latitude of PCA events during periods of the quiet Sun and from direct subcosmic ray observations made by balloons and satellites is considered. The anomalous entry of low-energy particles in the polar cap is considered in terms of the direct or indirect merging of the geomagnetic field with the interplanetary field. The asymmetrically deformed gross configuration of the Earth's geomagnetosphere, as confirmed by the IMP-1 satellite observations, favors the anomalous entry of low-energy particles in the polar cap. (IAA)

34487 GROWTH AND DECAY OF THE GEOMAGNETIC TAIL. Piddington, J. H. (Commonwealth Scientific and Industrial Research Organization, Melbourne). pp 417-27 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Expansion and contraction of the auroral oval, of the outer zone of geomagnetically trapped particles, of a zone of magnetic agitation and of other phenomena shows that the magnetic flux into a section of the magnetotail varies by a factor of ~ 2 above and below an average of $\sim 7 \times 10^{16}$ G cm^2. Some lines move to the tail after connection with the interplanetary lines while others remain closed and enter the tail through the "wings" of the magnetosphere. The relative proportions depend on the different frictional forces available. Return flow is by reconnection in neutral sheets, one between the two tail sections and the others on the outer tail surfaces. The former type of flow is responsible for most geomagnetic activity, ring current, and most auroral activity in the night sector. The latter type may inhibit magnetic activity and contribute to daytime auroras. (auth)

34488 ELECTRIC FIELDS AND PLASMA CONVECTION IN THE MAGNETOSPHERE. Hones, Edward W. Jr. (Los Alamos Scientific Lab., N. Mex.). pp 403-16 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Recent observations made with the Vela satellites and other space vehicles which are relevant to magnetospheric theories are discussed. These observations appear to provide indications of the relative importance of the various processes which have been used in getting solar wind energy into the magnetosphere. (M.O.W.)

34489 PLASMA DENSITY AND ACCELERATION IN THE TAIL FROM THE RECONNECTION MODEL. Speiser, T. W. (Imperial Coll. of Science and Tech., London). pp 393-402 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Particle motion was followed in model current sheets associated with near-earth neutral points and it was found that such models may be capable of explaining some observations of thin, intense auroral oval-associated, auroral forms. Reconnection model predictions for the plasma density in the body of the tail are compared with observations. (M.O.W.)

34490 RECONNECTION MODEL OF THE MAGNETOSPHERE. Dungey, J. W. (Imperial Coll. of Science and Tech., London). pp 385-92 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The consequences of reconnection between the field lines of the interplanetary and geomagnetic fields are pursued and attempts are made to relate these to existing or possible observations. In addition to earlier interpretations relating polar substorms to tail reconnection, certain phenomena preceding substorms may be associated with dayside reconnection. The boundaries of the reconnection model are complex and, in particular, the model predicts a diffuse boundary at high latitudes at times of dayside reconnection. The observed variability of the interplanetary field leads to the prediction that the tail has several branches which represent obstacles in the magnetosheath; these obstacles moving more slowly than the surrounding plasma. Some boundaries may be detected by the standard magnetic and plasma observations and some may be associated with spikes of energetic particles even beyond the shock. North–south asymmetry of the tail is also discussed. (auth)

34491 PLASMA SHEET AND ADJACENT REGIONS. Bame, S. J. (Los Alamos Scientific Lab., N. Mex.). pp 373-83 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The geometry of the "plasma sheet" in the magnetosphere, as determined with electrostatic analyzers on the Vela satellites, is described. Some of the characteristics of the electrons and positive ions found in the plasma sheet and in regions bounding the sheet are also presented. (M.O.W.)

34492 SOLAR WIND OBSERVATIONS. Coon, J. H. (Los Alamos Scientific Lab., N. Mex.). pp 359-72 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Recent Vela 2 and Vela 3 satellite observations of the solar wind in the region of space near earth are summarized. (M.O.W.)

34493 CONSIDERATIONS OF SOLAR WIND–MAGNETOSPHERE INTERACTIONS. Parker, Eugene N. (Univ. of Chicago). pp 357-8 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The objectives of studying solar-wind interactions with the magnetosphere are outlined. A brief discussion of the following conference papers is given. (M.O.W.)

34494 THE STIMULATION OF EMISSIONS IN THE WHISTLER MODE. Das, A. C. (Imperial Coll. of Science and Tech., London). pp 351-4 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

A mechanism which must occur whenever a Whistler mode wave packet propagates through a hot plasma is briefly outlined. (M.O.W.)

34495 SATELLITE OBSERVATIONS OF VLF EMISSIONS AND THEIR ASSOCIATION WITH ENERGETIC CHARGED PARTICLES. Gurnett, Donald A. (Univ. of Iowa, Iowa City). pp 337-49 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

A summary of recent satellite observations of vlf emissions is presented. The intensities and regions of occurrence for various types of vlf emissions are summarized and simultaneous charged particle fluxes and vlf measurements available from the INJUN III satellite are compared. (M.O.W.)

34496 CYCLOTRON-RESONANCE AND BOUNCE-RESONANCE SCATTERING OF ELECTRONS TRAPPED IN THE EARTH'S MAGNETIC FIELD. Roberts, Charles S. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 317-36 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Pitch-angle diffusion into the loss cone is an important loss mechanism for radiation-zone electrons trapped in the magnetosphere. This paper examines two wave–particle interactions which are likely to be important for producing pitch-angle scattering. These are cyclotron-resonance scattering by whistler-mode disturbances and bounce-resonance scattering by disturbances having electric- or magnetic-field components parallel to the earth's magnetic field. Both mechanisms can operate effectively not only with sinusoidally varying disturbance fields but also with irregular, noise-like field fluctuations. The latter have rather wide-band power-spectral-density functions, and the strength of the scattering is proportional to the power present at the frequency appropriate to produce either cyclotron or bounce resonance. Irregular whistler-mode disturbances with rms magnetic-field fluctuations of the order of 10^{-3} γ or higher are significant in producing rates of pitch angle diffusion in agreement with observed electron lifetimes in the slot and outer electron zone. If the whistler-mode power-spectral density function decreases rapidly with increasing frequency, then this mechanism may have difficulty in explaining the pitch-angle scattering of nearly equatorially mirroring electrons. Contributions from bounce-resonance scattering can also be significant for the pitch-angle diffusion of relativistic electrons. This requires irregular parallel electric-field fluctuations of the order of 0.01 to 0.1 V/km rms or magnetic-intensity fluctuations of the order of 10^{-5} to 10^{-4} rms of the earth's magnetic intensity at the equator of the line of force of interest. The experimentally observed loss of radiation-zone electrons may actually be due to a combination of the two mechanisms, bounce resonance being more important for electrons mirroring near the magnetic equator and cyclotron resonance being dominant for electrons mirroring sufficiently far off the magnetic equator. (auth)

34497 DYNAMICAL MOTION OF GEOMAGNETIC FLUX TUBE RESULTING FROM INJECTION OF HIGH-ENERGY PARTICLES. Cladis, J. B. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). pp 307-16 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The simple model used in this analysis predicts that injection of a heated plasma in a magnetic tube of force will cause the tube to oscillate with periodic electric fields appearing both across and along the magnetic field lines. The period of the oscillation depends on the length of the tube and on the plasma loading. Particle injection, the Pi 2 micropulsations, and periodic electron precipitation which have been correlated with magnetic bay activity, indicate evidence of this process. The model also predicts that the azimuthal drift of a narrow energy group of particles will excite multiply coupled resonances of the field lines. Auroral rays and draperies appear to result from these resonances. Further evidence of this basic process is indicated by the observed fluctuations of magnetic filaments at the sun, the x rays and Type III radio bursts which sometimes appear during the initial phase of a flare, and the flares themselves. Preliminary results indicate that a magnetic tube containing a large injection of plasma executes more complex motions. At first it drifts outward toward larger equatorial-crossing distances, but later drifts inward to an equatorial distance substantially less than that of the initial position of the tube. The possible occurrence of this process is interesting because it predicts rapid transport of energetic plasma from the outer toward the inner magnetosphere. (auth)

34498 STORM-TIME RADIATION BELT. Akasofu, S.-I. (Univ. of Alaska, College). pp 295-306 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

It has been established that an intense radiation belt grows deep in the trapping region of the magnetosphere during geomagnetic storms. The storm-time belt (or the so-called "ring current") is particularly of interest, because even during a moderate storm it has much greater energy than any other permanently existing belts and thus, it can deform considerably the structure of the magnetosphere. The purpose of this paper is to review briefly the important features of the belt and discuss some of the major unsolved problems related to the formation of the belt. (auth)

34499 INFLATION MODEL FOR THE MAGNETIC STORM OF APRIL 17, 1965. Cahill, L. J., Jr. (Univ. of New Hampshire, Durham). pp 287-93 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The inflation of the magnetosphere between $L = 3$ and $L = 6$ at latitudes from 0 to 25° during the April 17, 1965, storm, has been presented in summary form. If certain assumptions are made, adiabatic changes in particle energy may be calculated, using the inflation measurements. In addition, the ring current model of Akasofu has been fitted to the measurements, allowing calculation of field distortion in regions not covered by the satellite measurements. A speculative description of the asymmetric inflation has also been made which may be useful in accounting for adiabatic particle energy changes in the early part of the storm. (auth)

34500 ELECTRIC FIELDS IN THE UPPER ATMOSPHERE. Haerendel, G.; Luest, R. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). pp 271-85 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The method of injecting artificial ion clouds into the upper atmosphere for the purpose of dc electric field measurements is discussed. Measurements in the auroral zone are described. (M.O.W.)

34501 MEASUREMENTS OF TIME-VARYING ELECTRIC FIELDS. Scarf, Frederick L. (TRW Systems, Redondo Beach, Calif.). pp 247-70 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The need for making ac electric field measurements in the ionosphere and magnetosphere is reviewed. Arguments for or against the various techniques are contained in the cited literature. (M.O.W.)

34502 VLF ELECTRIC FIELD PROBES. Storey, L. R. O. (CNRS, Saint-Maur-des-Fosses, France). pp 235-45 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Probe methods for measuring time-varying electric fields in ionospheric plasma are discussed. The discussion is confined mainly to the range from zero frequency upwards in which probe theory applies. Measurements apply to the D, E, and F regions of the ionosphere, together with the topside-F region up to the base of the protonosphere around 1000-km altitude. (M.O.W.)

34503 WAVE–ENERGETIC PARTICLE ASSOCIATIONS IN THE MAGNETOSPHERE. Anderson, K. A. (Univ. of California, Berkeley). pp 429-39 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The wave–energetic particle associations presently known from observational work are summarized in tabular form. Also summarized and briefly discussed are results of a recent study which deals with motions of the magnetopause, periodic modulation of energetic electron fluxes, and bow shock spikes. (M.O.W.)

34504 EMPIRICAL VALUES OF THE RADIAL DIFFUSION COEFFICIENT FOR ELECTRONS AT $1.15 < L < 1.21$. Walt, M.; Newkirk, L. L. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). pp 209-15 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

An empirical evaluation is presented of the diffusion coefficient for motion of energetic electrons across L shells in the range $L = 1.15$ to 1.21. It is assumed that the nonadiabatic motion of the inner-belt trapped electrons is governed by collisions with the atmosphere and by some unidentified diffusion process which conserves both the magnetic moment and the integral invariant. The atmospheric scattering losses are calculated, and the diffusion coefficient is then evaluated in order to satisfy the observed long-term decay rate and the measured radial flux profile. (M.O.W.)

34505 SHELL SPLITTING AND RADIAL DIFFUSION OF GEOMAGNETICALLY TRAPPED PARTICLES. Roederer, Juan G. (Univ. of Denver). pp 193-208 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The adiabatic motion of energetic charged particles in a model magnetosphere and its effects during prototype time variations are discussed. Reference is made exclusively to particles of high enough energy so that the effect of electric fields can be neglected. (M.O.W.)

34506 DIFFUSION THEORY OF TRAPPED PARTICLES AND THE OBSERVED PROTON DISTRIBUTION. Haerendel, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). pp 171-91 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The diffusion equation for the general n-dimensional is derived. The diffusion caused by perturbations with characteristic time scales near the drift period is discussed. The proton component is discussed. (M.O.W.)

34507 RADIAL DIFFUSION BY VIOLATION OF THE THIRD ADIABATIC INVARIANT. Faelthammar, Carl-Gunne (Royal Inst. of Tech., Stockholm). pp 157-69 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The problem of relating the coefficient D of radial diffusion to the electric or magnetic fields that are necessary for the diffusion to occur is discussed. In relating the diffusion coefficient to the disturbance fields, particles with arbitrary mirror latitude are discussed. (M.O.W.)

34508 EXPERIMENTAL EVIDENCE ON RADIAL DIFFUSION OF GEOMAGNETICALLY TRAPPED PARTICLES. Roederer, Juan G. (Univ. of Denver). pp 143-55 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Data suggesting the possible radial diffusion of trapped particles are reviewed. The possibility for outward radial diffusion is also discussed. (M.O.W.)

34509 DISTRIBUTION AND ENERGY SPECTRUM OF ALPHA PARTICLES IN THE RADIATION ZONES. Krimigis, S. M.; Van Allen, J. A. (Univ. of Iowa, Iowa City). pp 127-40 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Observations were made with the University of Iowa INJUN IV satellite which was launched on November 21, 1964, into a nearly polar orbit of 81° inclination with initial apogee altitude of 2502 km and perigee altitude of 527 km. It carried a 25 micron thick, totally depleted silicon surface barrier detector with four electronic discrimination levels. The two lower levels are sensitive to protons $0.516 \leq E_p \leq 4$ MeV and $0.90 \leq E_p \leq 1.8$ MeV, respectively. The two upper levels are sensitive only to nuclei heavier than hydrogen and, specifically, are sensitive to α-particles $2.09 \leq E_\alpha \leq 15$ MeV and $3.89 \leq E_\alpha \leq 7$ MeV, respectively. Results from the available data up to April 17, 1965, are discussed. (M.O.W.)

34510 SATELLITE MEASUREMENTS OF AURORAL PARTICLE PRECIPITATION. Sharp, R. D.; Johnson, R. G. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). pp 113-25 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

A survey of measurements on precipitating particles causing aurora is presented. Various characteristics of the particles are discussed. (M.O.W.)

34511 LOW-ENERGY PARTICLES MEASURED BY OV1-9 (1966-111A). Katz, Ludwig (Air Force Cambridge Research Labs., Bedford, Mass.); Kuck, George A.; Rothwell, Paul L.; Frankenthal, S.; Paolini, F. R.; Theodoridis, G. C. pp 103-12 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Low-energy protons and electrons were measured by satellite 1966-111A. The trapped electron fluxes did not show a distinct peak in the counting rate vs L curves when measured at a constant $B \sim 0.01$ gauss. At $L \sim 4$, the differential spectrum was of the form exp ($-E/36$ keV). The proton fluxes were in qualitative agreement with inward radial diffusion conserving the first two adiabatic invariants. The peak flux as a function of L at a particular energy followed the theoretical predictions based on the assumption of equatorial diffusion. The spectra became softer with increasing L and the peak flux as a function of L became broader with decreasing particle energy. However, detailed spectral shapes at these small equatorial pitch angles did not agree with the equatorial diffusion predictions. (auth)

34512 OBSERVATIONS OF LOW-ENERGY ($\sim$0.5 MeV) TRAPPED PROTONS WITH INJUN IV. Krimigis, S. M. (Univ. of Iowa, Iowa City). pp 89-101 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The detector complement of the University of Iowa satellite INJUN IV, launched on November 21, 1964, into a high-latitude low-altitude orbit, includes a 25-μ totally depleted surface-barrier detector with four discrimination levels, two of which are sensitive to protons in the energy interval $0.52 \leq E_p \lesssim 4$ MeV (channel A) and $0.90 \leq E_p \leq 1.8$ MeV (channel B), and insensitive to electrons of any energy. An analysis of the data for the period March 1 to April 17, 1965 has shown: (1) Maximum intensities occur at $L \simeq 3.05$ and $|B| = 0.16$ gauss of 1.5×10^5 (cm^2 sec sr)$^{-1}$ for A and of 4×10^4 (cm^2 sec sr)$^{-1}$ for B. (2) The intensity maximum moves to higher L values as $|B|$ increases. (3) Time variations generally occur for $L \geq 4.5$ and $|B| \gtrsim 0.30$, except during major magnetic storms when time variations are observed for $L \gtrsim 2.2$. (4) The energy spectrum may be described by $dj/dE = K/E_0\, e^{-E/E0}$, with E_0 ranging from $\sim$0.38 at $L = 2.1$ to 0.13 MeV at $L \approx 4.8$. (5) The boundary is located at $L \sim 5.6$ for protons of $E_p \gtrsim 0.52$ MeV and at $L \sim 4.8$ for $E_p \geq 0.90$ MeV. The data are compared to the model of Nakada et al. (1965) and found to agree qualitatively with their predictions. Following the April 17, 1965, magnetic storm, the distribution of 0.5-MeV protons became bifurcated with a primary intensity peak at $L \simeq 2.75$ and a secondary one at $L \sim 3.5$. (auth)

34513 ON THE DISTRIBUTIONS OF LOW-ENERGY PROTONS AND ELECTRONS IN THE EARTH'S MAGNETOSPHERE. Frank, L. A. (Univ. of Iowa, Iowa City). pp 67-87 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Data are given on low-energy charged particle observations within the Earth's magnetosphere during 1965. Measurement techniques are briefly described. (M.O.W.)

34514 THE ARTIFICIAL ELECTRON BELT, OCTOBER 1963 TO OCTOBER 1966. Beall, D. S. (Johns Hopkins Univ., Silver Spring, Md.). pp 57-64 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Satellite 1963 38C, launched September 28, 1963, into a polar orbit at 1100 km, continues to operate normally as of July 1967. This paper deals with the measured decay of the Starfish electron radiation belt over a 37-month period commencing 15 months after the Starfish high-altitude nuclear detonation of July 9, 1962. The present work summarizes the main results of a 27-month study (Beall et al., 1967) and extends the time coverage to 3 years. The latest data collection interval occurs in October 1966. (M.O.W.)

34515 LOCAL TIME ASYMMETRIES NEAR THE HIGH LATITUDE BOUNDARY OF THE OUTER RADIATION ZONE. Burrows, J. R.; McDiarmid, I. B. (National Research Council of Canada, Ottawa). pp 45-56 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Data obtained from the Alouette II satellite are used to examine various high-latitude boundaries. Four electron boundaries in the outer radiation zone and a polar cap proton boundary are defined, and all five of the boundaries show a marked dependence on local magnetic time (LMT). The 35-keV "smooth" and the 3.9-MeV "background" boundaries for electrons are identified with the stable trapping region and show an asymmetry of about 3° along a 1100 to 2300 hr axis. The 35-keV background boundary which falls at higher latitudes than the other boundaries at all local times, has a noon-midnight asymmetry of about 6° as well as a marked dawn-dusk asymmetry. The 35-keV background boundary is tentatively associated with the boundary of closed geomagnetic field lines and it is suggested that there is a dawn-dusk asymmetry in the field configuration. The 35-keV "sharp" boundary is identified with the inner edge of the "cusp" region. The relationship of the polar-cap proton boundary to the electron boundaries is examined. (auth)

34516 ENERGETIC OUTER-BELT ELECTRONS AT SYNCHRONOUS ALTITUDE. Brown, W. L. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 33-43 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Observations were made of the temporal variation in the energetic electron flux at synchronous altitude with a multi-element semiconductor detector telescope on the ATS-1 satellite. Systematic diurnal changes and more rapid oscillations that are attributable to the longitudinal drift of bunches of electrons have been studied. The diurnal variations on a magnetically quiet day were compared with the calculations of adiabatic motion in a distorted field, assuming simple radial and pitch-angle distributions of electrons in the noon meridian. This model is too simple to explain the observations satisfactorily and several modifications are considered. The electron flux oscillations have periods approximately inverse with electron energy as expected. The absolute magnitudes of the periods, while close to the values calculated following Roederer (1967), differ enough to indicate the need for alteration of the model of the distorted field. (auth)

34517 LOW-ALTITUDE, OUTER-BELT MEASUREMENTS: SPACE AND TIME VARIATIONS IN RELATIVISTIC ELECTRON SPECTRA, AND RADIAL DIFFUSION. Paolini, F. R. (American Science and Engineering, Cambridge, Mass.); Theodoridis, G. C.; Frankenthal, S.; Katz, L. pp 23-32 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Energy spectra for electrons of 1 to 4 MeV have been obtained at low altitudes in the outer belt with a scintillation spectrometer aboard Hitch-Hiker I during July and August 1963. Observed time variations and spatial dependence suggest that the transport of relativistic electrons across L shells can be qualitatively understood as the interplay of two processes: (a) Radial diffusion with conservation of first and second adiabatic invariants, resulting in spectra monotonically decreasing with L, and (b) Radial diffusion arising from shell splitting and pitch angle diffusion, consistent with energy spectra independent of L for $L > 4$. Process (a) seems to be predominant during magnetically active periods. (auth)

34518 OBSERVATIONS OF INNER-ZONE PROTONS IN NUCLEAR EMULSIONS 1961 TO 1966. Filz, Robert C. (Air Force Cambridge Research Labs., Bedford, Mass.). pp 15-22 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

The time behavior of 55-MeV trapped protons was determined from measurements in low-altitude polar orbiting Air Force satellites from 1961–1966. The data are fitted to power law functions of the form $J = CH^k$ for seven different periods. Except for the increase caused by Star Fish in 1962, no large, short-time scale fluctuations are observed. The decay following Star Fish is initially consistent with ionization loss but 1964 and 1965 data indicate that the atmospheric density has decreased as expected at the minimum phase of the solar cycle. The 1966 data tend to indicate that atmospheric densities are increasing again but further observations are required to confirm this effect. (auth)

34519 RECENT RESULTS OF INNER ZONE PARTICLE FLUXES. Freden, S. C.; Blake, J. B.; Paulikas, G. A. (Aerospace Corp., El Segundo, Calif.). pp 3-14 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Some recent data, calculations, and interpretations of inner-zone proton fluxes and spectra and their time variations are presented. Sources and losses are discussed. Recent measurements of inner zone electron fluxes and spectra are also given and comparisons are made with pre-Starfish and earlier post-Starfish data. Decay lifetimes for the Starfish electrons are shown. (auth)

34520 EARTH'S PARTICLES AND FIELDS. Proceedings of the NATO Advanced Study Institute held at Freising, Germany, July 31–August 11, 1967. McCormac, Billy M. (ed.). New York, Reinhold Book Corporation, 1968. 472p. $27.50.

Separate abstracts were prepared for 34 of the included papers. (M.O.W.)

For abstracts of individual papers see: 34487–34519 and 34574.

Low-Temperature Physics

34521 CRITICAL CURRENT DENSITY IN TYPE-II SUPERCONDUCTORS WITH ORIENTED PINS. Yamafuji, K.; Takeo, M.; Irie, F. (Kyushu Univ., Fukuoka). Phys. Lett., 27A: 104-5 (June 3, 1968).

A critical current and a transverse voltage are calculated as a function of the angle between current and rolled directions. The results show better agreements with experimental data than those derived from the concept of the "complete guided motion". (auth)

34522 HELICON-LIKE OSCILLATION IN SUPERCONDUCTING TIN. Ogasawara, T. (Nihon Univ., Tokyo); Yasukochi, K.; Akachi, T. Phys. Lett., 27A: 108-9(June 3, 1968).

Helicon-like oscillations were observed in the intermediate state of high-purity tin in static magnetic fields below H_c at 1.2°K. The angular frequency of the helicon wave was found to be nearly independent of the magnetic field H_z applied perpendicular to the specimen surface, whereas in the normal state the frequency is proportional to H_z. (A.G.W.)

34523 SUPERCONDUCTIVITY IN METASTABLE BISMUTH EUTECTIC ALLOYS. Gordon, D. E.; Deaton, B. C. (General Dynamics, Fort Worth, Tex.). Phys. Lett., 27A: 116-17(June 3, 1968).

The superconducting transition temperature T_c has been measured in several bismuth eutectic alloys after exposure to 30 kbar pressure. It is found that the changes observed in T_c can be related to changes in the normal-state resistivity of these samples. (auth)

34524 PHENOMENOLOGICAL THEORY OF THE ROUNDING OF THE RESISTIVE TRANSITION OF SUPERCONDUCTORS. Abrahams, E.; Woo, J. W. F. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Lett., 27A: 117-18(June 3, 1968).

The effect of order-parameter fluctuations on conductivity above and near the normal–superconducting transition is calculated by means of the time-dependent Ginzburg–Landau equation. The result for films agrees with experiment and microscopic calculation. (auth)

34525 UPPER CRITICAL FIELD OF SUPERCONDUCTING TIN AND LEAD FILMS DISORDERED DUE TO DEPOSITION ON SUBSTRATES HELD AT LOW TEMPERATURE. Brown, Richard Wellman. College Park, Md., Univ. of Maryland, 1967. 137p. Thesis.

Measurements have been made of the parallel magnetic field (upper critical field) required for resistive onset in films of superconducting tin and lead. These films were initially highly disordered because of deposition on substrates held at liquid helium temperature; measurements were made on the films as deposited, after annealing to temperatures around 100°K, and fully annealed. The degree of annealing was inferred from the residual resistivity after temperature cycling; both tin and lead films show no further decrease in residual resistivity if brought to room temperature. The resistive onset was made more definite by scoring the edges of the films while they were still at liquid helium temperature. The upper critical field was then measured as a function of temperature, electron mean free path (reflected in the residual resistivity), and film thickness. The films as deposited have higher critical fields than after partial annealing. Beyond a certain combination of film thickness and increasing degree of disorder, a film will switch from thin to thick behavior at some value of reduced temperature. Thin here means thin compared to the magnetic penetration depth, thick behavior is that of the bulk material. The results have been analyzed in the framework of the Ginzburg–Landau theory, which gives predictions for the upper critical field in terms of the thermodynamic critical field (H_c) and the penetration depth (λ_p), the temperature dependences entering through these quantities. With this approach, fair agreement for the upper critical field values is found between theory and experiment, and excellent agreement with the temperature dependence. The temperature dependence for a film that acts thin is the square root of that for a film that acts thick. For a film that switches from thin to thick behavior at some value of upper critical field, the switch occurs, after partial annealing, at the same value of field, now reached at a lower temperature. This is interpreted to indicate: (a) that the spatial range of a structural (Abrikosov) solution to the Ginzburg–Landau equation is a function of H applied when one is close to the upper critical field, and (b) that a film will switch from thin to thick behavior when such a solution in some sense "fits" inside the film. Some attention is paid the problem of the role of surface modes in the resistive onset of films. (Diss. Abstr.)

34526 ON THE DEPTH OF MAGNETIC FIELD PENETRATION IN A SUPERCONDUCTOR MODEL WITH OVERLAPPING ZONES. Geilikman, B. T.; Zaitsev, R. O.; Kresin, V. Z. (Inst. of Physics and Technology, Moscow). Fiz. Metal. Metalloved., 25: 172-5(Jan. 1968). (In Russian).

An expression relating the current density Fourier component j(q) to the vector potential Fourier component. A(q) for the case in which one part of the zone is represented by a Peppard equation ($\xi > \delta$) and the other part by the London equation ($\xi < \delta$) was found previously. An attempt was made to confirm the expression for the depth of magnetic field penetration δ as a function of temperature intermediate between the Peppard and London expressions ($\xi_i = hv_i/\Delta_i(0)$, when Δ_i and v_i are energy gap and the rate on the Fermi surface in i zone, respectively). (R.V.J.)

34527 INFLUENCE OF METALLURGICAL FACTORS ON THE FLUX DISTRIBUTION IN SUPERCONDUCTORS. Sarma, N. V. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). Phil. Mag., 17: 1233-45(June 1968).

The magnetic-flux distribution on the end faces of superconducting discs at 4.2°K was observed by a Bitter-pattern technique and compared with the metallurgical structure of the specimens. Second-phase regions of $CaPb_3$ in two-phase lead–calcium alloys, compositional inhomogeneity in single-phase lead–indium alloys, and grain boundaries and surface scratches in V_3Si are some of the features that give rise to flux pinning. The results suggest that the effectiveness of any pinning centre depends on its size in relation to the coherence length of the superconducting matrix and on the gradient of the Ginzberg–Landau parameter around the pinning centre. (auth) (UK)

34528 UPPER CRITICAL FIELD OF WEAKLY COUPLED LINEAR CHAINS. Barisic, S.; de Gennes, P. G. (Centre National de la Recherche Scientifique, Orsay, France). Solid State Commun., 6: 281-3(May 1968).

A system of weakly coupled superconducting chains (with overall cubic symmetry) may show a high and strongly anisotropic upper critical field at temperatures only slightly below T_c. (auth) (UK)

34529 SUPERCONDUCTIVITY ELECTRON MECHANISM IN SEMICONDUCTORS AND SEMIMETALS. Geilikman, B. T.; Kresin, V. Z. (Moscow State Teacher's College by Correspondence). Fiz. Tekh. Poluprov., 2: 764-6(May 1968). (In Russian).

A theoretical analysis is given of the possibility of electron mechanism of superconductivity in semiconductors, semimetal, and molecular crystals. The studies are based on the previously published data by B. T. Geilikman, Yu. A. Larkin, M. Cohen, and others. (R.V.J.)

34530 SUPERCONDUCTING PHOSPHORUS. Wittig, J.; Matthias, B. T. (Univ. of California, San Diego). Science, 160: 994-5(May 31, 1968).

Phosphorus, the element itself, becomes superconducting near 4.7°K and at pressures exceeding 100 kilobars. This constitutes one of the four last missing links in the proof that superconductivity is normal behavior for every truly metallic sp element. The three remaining ones are arsenic, sulfur, and iodine. (auth)

34531 MOTION OF NEGATIVE IONS ALONG QUANTIZED VORTEX LINES. Glaberson, William I.; Strayer, Donald M.; Donnelly, Russell J. (Univ. of Oregon, Eugene). Phys. Rev. Lett., 20: 1428-31(June 17, 1968).

The motion of negative ions trapped in quantized vortex lines in rotating helium II has been measured down to 0.8°K by means of a time-of-flight apparatus. Trapped ions always move more slowly than free ions at the same temperature. The contribution of the extra retardation due to the vortex line appears to vary as $\exp(-\Delta/kt)$, where $\Delta/k = 1.87$°K between 0.8 and 1.5°K. (auth)

34532 NUCLEATION OF SUPERCONDUCTIVITY ABOVE H_{c3}. van Gelder, A. P. (Katholieke Univ., Nijmegen, Netherlands). Phys. Rev. Lett., 20: 1435-6(June 17, 1968).

It is shown theoretically for systems with a special geometry that nucleation of superconductivity can occur for magnetic fields above H_{c3}. (auth)

34533 EXPERIMENTAL TECHNIQUES IN LOW-TEMPERATURE PHYSICS. (SECOND EDITION). White, G. K. Monographs on the Physics and Chemistry of Materials. Oxford, Clarenden Press, 1968. 409p. 75s.

The subject is treated under the following main headings: general (production of low temperatures; storage and transfer of liquefied gases; heat exchangers; temperature measurement; cooling with helium-3); the research cryostat (introduction to cryostat design; heat transfer; temperature control; adiabatic demagnetisation; vacuum techniques and materials); physical data (heat capacity and expansion coefficient; electrical and thermal resistivity). (UK)

34534 SPIN COMPENSATION IN AN ELEMENT, CERIUM. Edelstein, Alan S. (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev. Lett., 20: 1348-51(June 10, 1968).

The low-temperature susceptibility above the magnetic ordering temperature of La–Ce alloys (Ce concentration ≤40 at. %) and of α–Ce and β–Ce is proportional to $T^{-1/2}$. This is the temperature dependence recently suggested by Anderson in the case of spin compensation. The susceptibility per Ce atom for the alloys above the magnetic ordering temperature is independent of Ce concentration. It is suggested that these systems exhibit spin compensation. (auth)

34535 PAIRING CRITERION IN ELECTRON MECHANISM FOR SUPERCONDUCTIVITY. Geilikman, B. T. Sov. Phys.-Solid State (Engl. Transl.), 9: 2651-2(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3359-61(Nov. 1967).

The electron mechanism for superconductivity for the case of a metal having two overlapping bands (a broad one, a, and a narrow one, b) is considered. In particular, a quantity α_b that determines the behavior of the Coulomb matrix element describing the interaction of the b electrons is evaluated, and conditions favorable to pairing are discussed. (A.G.W.)

34536 THERMAL PROPERTIES OF SUPERCONDUCTORS WITH A STRONG ELECTRON–PHONON INTERACTION. Geilikman, B. T.; Kresin, V. Z. (Moscow State Teachers College). Sov. Phys.-Solid Sate (Engl. Transl.), 9: 2453-9(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3111-19(Nov. 1967).

The behavior of superconductors with strong coupling has been studied for temperatures near the critical temperature. An equation describing the temperature dependence of the energy gap is derived. It is shown that, by going beyond the limits of the weak-coupling approximation, one can obtain a discontinuity in heat capacity β larger than that given by the usual theory, according to which $\beta < 2.43$. For Pb $\beta = 3.4$, in agreement with the experimental data. The electronic thermal conductivity of anomalous superconductors is considered also. (auth)

34537 SUPERCONDUCTING ULTRAHIGH-Q TUNABLE RF PRESELECTOR. Arams, Frank R.; Fradkin, Joseph; Kornfeld, David; Sard, Eugene W.; Siegel, Kenneth (Airborne Instruments Lab., Deer Park, N. Y.). IEEE (Inst. Elec. Electron. Eng.) Trans. Electro-Magnet. Compatibility, EMC-9: 110-23(Dec. 1967).

The application of superconductivity to the problem of reducing rf interference (RFI) is described. A low-loss, extremely narrowband superconducting filter was developed that is tunable from 6.3 to 21 MHz. This filter has an unloaded Q of 350,000 to 600,000 over the tuning band, bandwidth adjustable from 60 Hz to 50 kHz, calibrated external controls for frequency tuning and bandwidth adjustment, and good resettability and stability. An optimum circuit design provides minimum bandwidth variation with frequency tuning and minimum resonant frequency variation with changes in bandwidth. Performance tests on high-frequency receivers showed reductions in intermodulation interference susceptibility of 40 dB and improvements in FSK Teletype signals of 23 dB. (BBB)

34538 THERMAL PROPERTIES OF He II ACCORDING TO A LANDAU THEORY OF PHASE TRANSITIONS OF SECOND ORDER. Stenschke, Herbert; Falk, Gottfried (Univ., Karlsruhe, Ger.). Z. Phys., 212: 308-14(1968).

A special type of Landau theory of second-order phase transitions allows the incorporation of spatial fluctuations of the order parameter in a consistent way. The resulting theory describes the thermal properties of He II T_λ in agreement with experiment. (auth)

34539 QUADRATIC RESPONSE OF THE INTERMEDIATE STATE TO A TRANSVERSE ALTERNATING MAGNETIC FIELD. McLachlan, D. S. (IBM Zurich Research Lab.). Phys. Kondens. Mater., 7: 226-31(Apr. 9, 1968).

The response or susceptibility of the intermediate state in a transverse cylinder of indium to a small alternating magnetic field perpendicular to both the static magnetic field and the axis of the cylinder is studied as a function of frequency, size, resistivity, and temperature. The response is quadratic as a second harmonic signal is generated in a pickup coil axial to the static magnetic field. At sufficiently low frequencies the quasi-static limit is attained. An intermediate frequencies the signal is eddy-current-damped, and at higher frequencies the signal is dependent on the structure of the intermediate state. (auth)

34540 ZERO BIAS TUNNELING CONDUCTANCE FOR HIGH-FIELD SUPERCONDUCTORS. Engler, Hans (Univ., Frankfurt am Main); Fulde, Peter. Phys. Kondens. Mater., 7: 150-61 (Mar. 6, 1968).

The zero bias tunneling conductance is investigated theoretically and shown to be a promising experimental tool for detecting first-order phase transitions in high-field superconductors. The zero bias tunneling conductance for arbitrary spin orbital mean free path is calculated and evaluated numerically. In doing the calculations, thin films in a parallel field and high x-value materials in a perpendicular field are distinguished between. In the former case anomalous properties appear for sufficient long spin orbital mean free path. Finally the minimum spin orbital mean free path which is compatible with a first-order phase transition is determined and it is shown that it is much smaller than commonly believed. (auth)

34541 SUPERCONDUCTIVITY OF SMALL TIN PARTICLES MEASURED BY TUNNELING. Giaever, I.; Zeller, H. R. (General Electric Research and Development Center, Schenectady, N. Y.). Phys. Rev. Lett., 20: 1504-7(June 24, 1968).

Tunneling was used to study the superconductivity of small Sn particles imbedded in an oxide film. In contradiction to existing theories, no lower size limit for superconductivity has been found down to a particle radius r = 25 Å. The junction characteristic shows a large peak in resistance at zero bias even for normal particles. This resistance maximum can be explained in terms of a capacitor model of the particle. (auth)

34542 DIFFUSION OF QUASI PARTICLES IN SUPERCONDUCTING ALUMINUM FILMS. Hsieh, S. Y.; Levine, James L. (Columbia Univ., New York). Phys. Rev. Lett., 20: 1502-4 (June 24, 1968).

The diffusion of quasi-particle excitations in superconducting aluminum films has been observed. The measured diffusion constant D = 22.5 cm^2 sec^{-1} is in good agreement with an estimate based on the normal-state resistivity of the films. (auth)

34543 SUPERCONDUCTING TUNNELING IN THE LOW-TEMPERATURE PHASES OF GALLIUM. Wuehl, Helmut; Jackson, J. E.; Briscoe, C. V. (Univ. of North Carolina, Chapel Hill). Phys. Rev. Lett., 20: 1496-9(June 24, 1968).

The two low-temperature metastable phases of gallium have superconducting energy gap to transition temperature ratios, $2\Delta_0/kT_c$, of 4.5 for amorphous gallium and 3.9 for the crystalline phase, β Ga. Beta gallium shows considerable structure in the tunneling current indicating the presence of several well-defined peaks in the phonon density of states. Structure observed in the amorphous gallium tunneling current appears to be a smeared-out version of that observed in β Ga. (auth)

34544 NUCLEAR SPIN–LATTICE RELAXATION IN SUPERCONDUCTING MIXED STATE. Okubo, Noriaki; Masuda, Yoshika (Nagoya Univ., Japan). Phys. Rev. Lett., 20: 1475-7(June 24, 1968).

The nuclear spin–lattice relaxation time T_1 of ^{51}V in a type-II superconductor V_3Sn has been measured as a function of temperature as well as magnetic field. In the case of $T_c(0) > T_c(H) > 0.6T_c(0)$, the temperature variation of T_1 shows a minimum just below the critical temperature corresponding to the magnetic field in which T_1 was measured, $T_c(H)$, and then increases gradually. In the case of $T_c(H) < 0.6T_c(0)$, just below $T_c(H)$ corresponding to that field, T_1 shows no minimum but increases monotonically. (auth)

34545 CEROUS MAGNESIUM NITRATE THERMOMETRY AND THE MEASUREMENTS ON FERMI LIQUIDS. Anderson, A. C. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 20: 1474-5(June 24, 1968).

Measurements of demagnetization factors of cerous magnesium nitrate thermometers show that a recent criticism of liquid ^{3}He and ^{3}He–^{4}He experiments is not applicable. (auth)

34546 VELOCITY OF SECOND SOUND NEAR THE λ POINT OF HELIUM. Pearce, C. J.; Lipa, J. A.; Buckingham, M. J. (Univ. of Western Australia, Nedlands). Phys. Rev. Lett., 20: 1471-3(June 24, 1968).

Measurements of the velocity of second sound near T_λ are reported. It is found to vanish with the 0.386 power of $T_\lambda - T$. The results confirm the theoretical expression and permit a direct asymptotic comparison for the first time of independent but theoretically equal quantities. (auth)

34547 VORTEX-RING CREATION BY NEGATIVE IONS IN DILUTE MIXTURES OF ^{3}He–^{4}He. Rayfield, G. W. (Univ. of Oregon, Eugene). Phys. Rev. Lett., 20: 1467-8(June 24, 1968).

An experiment is described, which indicates that the addition of ^{3}He impurities to superfluid helium has a pronounced effect on the velocity at which negative ions produce vorticity (vortex rings). The ^{3}He impurities have no effect, however, on the creation of vorticity by positive ions. (auth)

34548 ONSET OF ODLRO AND THE PHASE TRANSITION IN THE IDEAL BOSON GAS. Luban, Marshall (Bar-Ilan Univ., Ramat Gan, Israel); Revzen, Michael. J. Math. Phys. (N. Y.), 9: 347-9(Mar. 1968).

The divergence of the constant-pressure specific heat C_P and the isothermal compressibility K_T as one lowers the temperature of the ideal boson gas to the transition temperature T_c is discussed in terms of the onset of off-diagonal long-range order (ODLRO) of the one-particle density matrix ρ_1. (auth)

34549 SURFACE AND BOUNDARY CONDITIONS IN THE THEORY OF DIRTY SUPERCONDUCTORS. Usadel, Klaus-Dieter (Univ., Goettingen, Ger.). Z. Naturforsch., 23a: 655-70(May 1968). (In German).

The kernel of the linearized integral equation for the order parameter $\Delta(r)$ was shown by de Gennes to be the solution of a diffusion equation in the case of a very impure superconductor. On the basis of the method of the correlation function originating from de Gennes and further developed by Lüders, boundary conditions to the diffusion equation are derived for surfaces and for interfaces between different conductors. In the case of good electrical contact, these results are identical with those given by de Gennes. (auth)

34550 ON THE MATHEMATICAL STRUCTURE OF THE B.C.S.-MODEL. II. Thirring, W. (Univ. of Vienna). Commun. Math. Phys., 7: 181-9(1968).

It is shown for the degenerate BCS model how, in the limit of an infinite system, the exact thermal Greens functions approach a gauge-invariant average of the ones calculated with the Bogolyubov–Haag method. (auth)

34551 NON-LONDONEAN RESISTANCE JUMP IN SUPERCONDUCTING INDIUM. Freud, R.; Sulkowski, Cz.; Makiej, B. (Inst. of Low Temperatures and Structure Researches, Wroclaw). Phys. Lett., 27A: 187-8(June 17, 1968).

According to the measurements reported, the resistance jump appearing in a superconducting cylinder with electric current at the transition into intermediate state amounts to about $^2/_3$ R_n and not to $^1/_2$ R_n as stated in the London theory. (auth)

34552 THE FLUX-LINE ARRANGEMENT IN THE INTERMEDIATE STATE OF TYPE-II SUPERCONDUCTORS. Essmann, U.; Traeuble, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Lett., 27A: 156-7(June 17, 1968).

By direct observation the flux-line arrangement in Pb–6.3 at. % In foils is studied in perpendicular magnetic fields $H_{ext} < H_{c1}$. A disturbed triangular flux-line lattice is observed. (auth)

34553 INFLUENCE OF STRUCTURAL DISORDER AND DEFECTS ON H_c IN QUENCHED THIN Pb AND In FILMS AND THE EFFECT OF THE CHOICE OF H_c. Bulow, H.; Schiller, C. K. (Wayne State Univ., Detroit). Contract AT(11-1)-1054. Phys. Lett., 27A: 163-4(June 17, 1968).

Large changes in critical field values are observed for quenched thin In and Pb films. The values obtained for Pb are compared with the results obtained by Lüders with deformed Pb wires. The importance of the right choice of H_c is pointed out. (auth)

34554 VORTEX WHEELS IN SUPERFLUID HELIUM. Sanders, T. M. Jr.; Weinreich, G. (Univ. of Michigan, Ann Arbor). Phys. Lett., 27A: 172-3(June 17, 1968).

It is suggested that the continuous reversal of apparent circulation around a vibrating wire in liquid He II is due to the motion of a vortex-line array called a vortex wheel. (auth)

34555 SUPERCONDUCTING CRITICAL CURRENTS OF Pb–Tl ALLOYS. Dichtel, K. (Institut fuer Theoretische Physik, Kiel); Koppe, H.; Sekula, S. T. Phys. Lett., 27A: 174-5(June 17, 1968).

An analysis of magnetization curves of Pb–Tl alloys shows that the critical current of annealed probes is given by $J_c = \text{const} \cdot (H_{c2} - H)^\mu$ for sufficiently high applied fields. (auth)

34556 DISTRIBUTION OF THE MAGNETIC INDUCTION IN THE TYPE-II CURRENT-CARRYING SUPERCONDUCTOR. Sikora, A.; Makiej, B.; Trojnar, E. (Inst. of Low Temperatures and Structural Researches, Wroclaw). Phys. Lett., 27A: 175-6 (June 17, 1968).

The magnetic induction along the radius of the In–6 at. % Pb cylindrical specimen (type-II superconductor) carrying the current has been measured by the bismuth probe method. In the resistive state of the sample a characteristic distribution of the magnetic induction occurs, which is different from that in the resistive state of the type-I superconductor. (auth)

34557 CHARACTERISTICS OF SUPERCONDUCTOR STRIP TRANSMISSION LINES WITH PERIODIC LOAD. Hsiao, J. K. (Naval Research Lab., Washington, D. C.). Bell Syst. Tech. J., 46: 1679-98(Oct. 1967).

The characteristic impedance and propagation constant for typical thin film superconducting strip lines used for interconnecting cryotron elements was derived using London's two-fluid model. The characteristic impedance is shown to be a real number with negligible frequency dependence. The propagation constant is shown to be directly proportional to frequency and hence the group and phase velocity is identical. The transmission performance of these lines is, for practical purposes, independent of film thickness when in excess of 500 Å. The characteristic impedance (Z_c) and delay time (t_c) is found for a film strip of 5 milli-inches width on SiO dielectric. For other widths, Z_c is inversely proportional to width and T_c is independent of width. At a dielectric thickness of 5000 Å and film width of 5 milliinches, Z_c = 0.725 ohm and $\tau_c = 8.2 \times 10^{-9}$ sec/m. The characteristic impedance (Z_0) and propagation constant for thin film superconducting strip line used as a common control which crosses a series of cryotron gates periodically spaced are derived in a separate section, with relation to the transmission characteristics (Z_c, τ_c) for the strip line if they did not cross cryotron gates. This relation is shown with plots of characteristic impedance and delay time per meter versus the ratio (K) of distance between gate crossing with gate width. For high packing density K = 1, it is found that the characteristic impedance is reduced almost 20% due to the loading of the gate crossings. The delay time τ_0 is increased 20%. (BBB)

34558 MICROWAVE STUDY OF PROXIMITY EFFECTS IN SUPERCONDUCTIVITY. Fischer, Gaston; Klein, Rudolf (Laboratories RCA Ltd., Zurich). Phys. Kondens. Mater., 7: 12-42(1968). (In German).

The superconductivity induced in Cu in close proximity with Pb was examined by the microwave surface resistance of the thin layer of Cu in contact with the Pb surface. It was found that the basic ideas about proximity effects in superconductivity developed in recent years can explain the observed behavior satisfactorily. The data gave evidence of a complex excitation spectrum in the Cu, with low-energy excitations above a true gap and a group of high-energy excitations which is usually observed in tunneling experiments. The response to a magnetic field showed that scattering at the free Cu surface is diffuse. This leads at low fields, where a Meissner shielding current flows at the Cu surface, to a decrease of the depairing energy by a large amount of first order in the vector potential $\underline{A}$ instead of only a small second order amount. This also explains an initial decrease of the absorption when a weak magnetic field is applied. For fields over a large range below the critical field of lead, superconductivity is effectively suppressed in Cu. The data also give information on the increase of the penetration depth in Pb because of the coating with Cu and on the effective electron-electron interaction in Cu. (BBB)

34559 SUPERCONDUCTIVITY OF QUENCHED CONDENSED Pb–Bi ALLOYS. Hasse, J.; Seiberth, J. (Technische Hochschule, Karlsruhe, Ger.). Z. Phys., 213: 79-88(1968). (In German).

By quenched condensation of various alloys in the Pb–Bi system the superconducting transition temperature of an amorphous phase could be obtained for all concentrations. During annealing new unknown phases were found and their transition temperatures were measured. The dependence of T_c on electron concentration of the amorphous phase is compared with that of the α-phase solid solution. A variation of the interaction parameter V with concentration is discussed. (auth)

34560 EFFECT OF THE DEGREE OF DEFORMATION OF THE CRYSTALLINE LATTICE OF INDIUM ON ITS SUPERCONDUCTIVITY. Lazarev, B. G.; Semenenko, E. E.; Kuz'menko, V. M. (Physical-Technical Inst., Tashkent). Fiz. Metal. Metalloved., 25: 273-7(Feb. 1968). (In Russian).

The effect of deformation of the crystalline lattice of In on the critical temperature and field was investigated. An increase of the critical temperature of the superconductive film was caused by a reduction of the Debye frequency. The greatest increase of the critical temperature during low-temperature condensation was observed at the lowest value of the parameter $\underline{q}$. The significant increase of the perpendicular magnetic field during low-temperature condensation was explained, as well as for parallel magnetic fields, by the decrease of the length of the free path of the conductivity electrons. (tr-auth)

34561 CRITICAL MAGNETIC FIELD OF THIN SUPERPOSED FILMS. Usadel, Klaus-Dieter (Univ., Goettingen, Ger.). Z. Phys., 213: 70-8(1968). (In German).

Thin superposed films of two superconductors or of a superconductor and a normal metal in a surface parallel magnetic field are considered, assuming that the mean free path of electrons is very short (dirty limit) and that the films are very thin (Cooper limit). From the linearized integral equation for the order parameter and the diffusion equation for the kernel with appropriate boundary conditions at the surfaces and at the interface, an equation for the critical magnetic field is derived. For small magnetic fields and for superposed films consisting of metals which are not too different in their physical properties, our results are in agreement with those obtained earlier by Klein and Fischer. For high magnetic fields, however, there are essential differences. (auth)

34562 ELECTRON DIFFRACTION PATTERNS OF Pb–Bi ALLOYS AT VERY LOW TEMPERATURES. Baier, Peter (Univ., Karlsruhe, Ger.). Z. Phys., 213: 89-100(1968). (In German).

By means of electron diffraction the structure of Pb–Bi films condensed onto a substrate at very low temperatures is investigated. Results are discussed with respect to the resistance measurements of Hasse and Seiberth. A sharp change in resistance normally corresponds to a change in diffraction pattern. Several new phases are observed. (auth)

34563 INFLUENCE OF ADDITIONS ON WORKABILITY, MICROSTRUCTURE, ELECTRICAL PROPERTIES, AND SUPERCONDUCTIVITY OF THE ALLOYS TiNb33 AND TiNb40. Bachmann, Dieter; Hedrich, Dieter; Kalsch, Elsbeth; Roeschel, Erich; Raub, Ernst; Zwicker, Ulrich (Univ., Erlangen-Nuernberg, Ger.). Z. Metallk., 59: 426-32(May 1968). (In German).

In annealed and β-quenched alloys the transition temperature of the alloys TiNb33 and TiNb40 is decreased by addition of oxygen and nitrogen. The increase of the transition temperature by annealing at 400 and 500°C is accelerated by cold working of the samples. Annealing between cold working decreases the range of transition to superconductivity, mainly at short annealing time. In β-quenched samples martensite formation is decreased by the addition of nitrogen and oxygen to the TiNb33 alloy. The thickness of the lamellas formed by cold working becomes smaller following the addition of nitrogen and oxygen to the TiNb33 alloy and similar to the thickness of the lamellas of the TiNb40 alloy. Without external magnetic field the critical current of the TiNb40 alloy is increased by addition of nitrogen and oxygen, but decreased with increased external magnetic field. Metallic additions to TiNb alloys with a valence electron concentration of 4.20 increase the transition temperature when copper, silver, gold, aluminum, gallium, indium, and germanium are present. Alloys with double additions show partly an increase and partly a decrease of the transition temperature of the corresponding alloys with only one metallic addition. There is an increase of the critical external field by metallic additions to the alloys with valence electron concentration of 4.20 but the critical field of TiNb40 (valence electron concentration 4.33) is not achieved. A smooth I_c/H curve is formed by the addition of silver to TiNb33. (auth)

34564 HALL EFFECT IN TYPE-II SUPERCONDUCTOR VANADIUM. Usui, N.; Ogasawara, T.; Yasukochi, K. (Nihon Univ., Tokyo). Phys. Lett., 27A: 139-40(June 17, 1968).

The Hall angle is observed in the mixed state of vanadium. Its field dependence indicates two different behaviors depending on the purity of the specimen. (auth)

34565 OSMOTIC PRESSURE AND ENTHALPY OF ISOTOPIC SOLUTIONS OF HELIUM. Varoquaux, Eric J. -A. (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 893-6(Apr. 1, 1968). (In French).

The thermodynamic functions of diluted solutions of ^{3}He in ^{4}He at very low temperature were constructed beginning with the Landau–Pomeranchuk model. The effective mass of ^{3}He in solution, found from measurements of the specific heat, was equal to 2.37 times the real mass of ^{3}He. The osmotic pressure and enthalpy were evaluated numerically at all temperatures in the framework of the model used. (tr-auth)

34566 INFLUENCE OF DISLOCATION ON THE SUPERCONDUCTIVITY OF NIOBIUM IN A MAGNETIC FIELD. Nembach, E.; Haasen, P. (Univ., Goettingen, Ger.). pp 885-92 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

The magnetization curve for niobium single crystals deformed to various amounts by torsion was measured at 4.2°K. From this the force which must work on a flux filament to intersect a dislocation was calculated. (auth)

34567 INFLUENCE OF VARIOUS SCATTERING PROCESSES ON THE SPECIFIC ELECTRIC IDEAL RESISTANCE OF PURE TUNGSTEN AT LOW TEMPERATURES. Berthel, K.-H. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 875-84 of Realstruktur und Eigenschaften von Reinststoffen. Teil 3. Kunze, J.; Pegel, B.; Schlaubitz, K.; Schulze, D. (eds.). Berlin, Akademie-Verlag, 1967. (In German).

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden. See CONF-650939.

The temperature dependence of the electrical resistivity of very pure W was studied in the temperature range of liquid He, H, and Ne and was also fitted with theoretical temperature functions. The estimated characteristic Θ_W was in good agreement with the characteristic Debye temperature Θ_D, calculated from the specific heat. (auth)

34568 FORCES ON FLUX VORTICES IN AN ARBITRARY CONFIGURATION. Evetts, J. E.; Campbell, A. M.; Dew-Hughes, D. (Univ. of Cambridge, Eng.). J. Phys., C, 1: 715-31(June 1968).

The general flux line distribution in a type-II superconductor in the mixed state is curved in three dimensions. In this paper flux line motion is treated using the methods of irreversible thermodynamics; a general condition for the flux line distribution to be stationary is obtained. The effects of pinning centers are included and forces acting in the mixed state are analyzed. The macroscopic critical-state equation in three dimensions is derived and its solution in some special cases discussed. (auth) (UK)

34569 MAGNETIC PROPERTIES OF SUPERCONDUCTING ALLOY FILMS. Davies, J. P. N.; Robinson, G.; Tilley, D. R. (Mullard Research Labs., Redhill, Eng.). J. Phys., C, 1: 699-714(June 1968).

Torque magnetometer studies of superconducting films of up to 6 at. % indium in tin were made. The general structure of the magnetization curves was similar to that observed earlier for tin and indium films; in particular, the curves were highly irreversible. In the parallel-field case the measurement was of the perpendicular moment $M_\perp$ induced by a small perpendicular field $H_\perp$. It is suggested that the appropriate way to describe the parallel-field curves is by the Bean model, with a critical current decreasing as the applied field increases. This seems to agree with the general shape of the experimental curves. Near to the critical field $H_{c||}$ Deltour and Tinkham (1967) proposed $J_c \propto 1 - (H_{||}/H_{c||})^2$ for films having a second-order transition to the normal state at $H_{c||}$. Not all of the data agreed with this form for J_c, and a simple model of a pinning center (a local thin spot) was used to suggest that J_c may decrease more rapidly near $H_{c||}$. The behavior of the film critical fields was generally in agreement with theory except that the perpendicular critical fields were about 20% high. (auth) (UK)

34570 THERMAL CONDUCTIVITY OF THE INTERMEDIATE STATE OF A SUPERCONDUCTOR. Rickayzen, G. (Univ. of Kent, Canterbury, Eng.). J. Phys., C, 1: 744-7(June 1967).

The thermal conductivity of the intermediate state of a superconductor is derived assuming that (i) the structure is lamellar, (ii) the electrons carry the heat, (iii) the electronic mean free path was much less than the width of the laminae, and (iv) there is thermal resistance at the boundary between normal and superconducting laminae due to the reflection of the electrons. The theory was applied to the experimental results of Mendelssohn and Shiffman (1960), and it was shown that a fit was possible only if the width of the laminae was very much less than that normally assumed. (auth) (UK)

34571 DENSITY OF STATES AND PHONON SPECTRUM OF SUPERCONDUCTING THALLIUM BY ELECTRON TUNNELLING. Clark, T. D. (Mullard Research Labs., Redhill, Eng.). J. Phys., C, 1: 732-43(June 1968).

The application of electron tunnelling to the study of superconductors is discussed and the results of tunnelling experiments involving superconducting thallium are described. It is shown that by measuring the first and second derivatives of the tunnel junction characteristics it is possible to determine the superconducting density-of-states variation in thallium and to draw some conclusions about the shape of its phonon spectrum. The principle peaks in the phonon spectrum (corresponding to the transverse and longitudinal modes) were found to occur at 4.0 and 9.45 MeV, respectively. The end of the phonon spectrum appeared to be located at 10.6 MeV and evidence for this and other critical points is presented. The average value of the full gap for thallium was found to be $2\Delta(0)_{Tl} = (0.74 \pm 0.02)$ MeV (i.e., $2\Delta(0)_{Tl} = (3.55 \pm 0.1)\ kT_c$) although considerable anisotropy of the gap was observed. Values of $2\Delta(Tl)$ ranging from 0.59 MeV to at least 0.97 MeV, and possibly 1.29 MeV, were measured. (auth) (UK)

Plasma and Thermonuclear Physics

34572 (TID–24491) QUARTERLY PROGRESS REPORT NO. 89 [ON ELECTRONICS]. Zimmermann, H. J.; Harvey, G. G.; Mason, S. J. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Apr. 15, 1968. 286p. Dep. CFSTI.

Separate abstracts were prepared for 20 of the included sections. (M.O.W.)

For abstracts of individual sections see: 34044, 34144, 34245, 34246, 34582, 34583, 34592–34594, and 34650–34660.

34573 PHYSIQUE DES PLASMAS. TOME 2. GAZ FAIBLEMENT IONISES. (Plasma Physics. Volume 2. Weakly Ionized Gases). Delcroix, J. L. Monographies Dunod. Paris, Dunod, 1966. 214p. 25,71F.

A textbook on the physics of weakly ionized gases is presented. Inelastic collision phenomena in an ionized gas are reviewed. The effect of an electric field on a weakly ionized gas is described. Free diffusion of electrons in a weakly ionized gas is considered. Intermediate plasmas are described. A description is given of the weakly ionized gases with a consideration of the mobilities and free diffusion coefficients. In a continuation of the description, the ambipolar diffusion, recombination, and attachment are discussed. (J.S.R.)

34574 SURVEY OF PLASMA PHYSICS. Thompson, W. B. (Univ. of California, San Diego). pp 219-34 of Earth's Particles and Fields. McCormac, Billy M. (ed.). New York, Reinhold Book Corp., 1968.

Basic plasma theory is reviewed. Topics such as the following are briefly discussed: MHD theory, Larmor radius expansion, Landau damping, stability, and turbulence. (M.O.W.)

Confinement and Heating of Plasma

34575 (AD–662908) DIFFUSION: A RELATIVISTIC APPRAISAL. Kelly, Don (Yale Univ., New Haven, Conn.). 1967. Contract Nonr-609(51). 17p. CFSTI.

The classic equation describing diffusion is not consistent with the principles of special relativity. Specifically, its solutions permit the diffusive flow of particles to proceed at speeds in excess of the speed of light. A careful derivation, proceeding from the covariant form of the Boltzmann equation, results in a diffusion equation which exhibits the correct causal behavior. This equation assumes a particularly simple form, known otherwise as the telegrapher's equation—when the collision frequency for momentum transfer is independent of particle speed. The general solution for diffusion in one dimension is presented, revealing the causal character of the diffusive flow. (auth) (USGRDR)

34576 (AD–663425) ANALYSIS OF A 4-BAR MIRROR CUSP MAGNETIC FIELD BY MEANS OF AN ELECTRON ANALOG DEVICE. White, Elmer (Air Force Aero-Propulsion Lab., Wright–Patterson AFB, Ohio). Sept. 1967. 16p. (AFAPL-TR–67–79). CFSTI.

The theory of singly charged particles in a positive gradient magnetic field was demonstrated by use of a thin electron beam. Analytically derived orbits and beam shapes are experimentally verified in an electron analog device. A correlation between an electron orbit in a low magnetic field and a high-energy proton in a high magnetic field is demonstrated analytically. The electron beam shapes in the presence of a 4-bar mirror cusp field derived in these experiments agree with the electron and proton orbital patterns derived analytically. (auth) (USGRDR)

34577 (AD–665528) NEGATIVE V DOUBLE PRIME SYSTEM AND ITS EQUILIBRIUM. Amano, Tsuneo (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov. 1967. 29p. (IPPJ–61). CFSTI.

A negative V'' configuration is obtained by applying $l = 2$ and $l = 3$ helical multipolar fields on a toroidal magnetic field. An analytical and numerical analysis indicates that the negative V'' condition can be achieved in a wide region in this way. (USGRDR)

34578 (CLM-R–78) METHOD FOR THE MICROWAVE HEATING OF PLASMA ELECTRONS. Hotston, E. S.; Weaver, J. M.; Wort, D. J. H. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Jan. 1968. 20p. Dep. CFSTI. UK 3s. 0d.

Examination of the Appleton–Hartree equation reveals the existence of a wave which propagates in the plasma and is subject both to strong collisional absorption and Landau damping, and which could thus be used to heat plasma electrons. The wave may be launched by coupling from a microwave slow-wave structure outside the plasma, although the launching efficiency is poor if a conventional TM structure is used. If a TE structure can be developed, the coupling to the plasma would be greatly improved. A free-space treatment of the coupling is supported by an alternative treatment which regards plasma and slow-wave structure as an integrated whole; this allows a rigorous analysis of the effect of the plasma boundaries and permits the inclusion of nonuniform plasma, but cannot give the efficiency of the coupling between structure and plasma. It is concluded that provided an efficient TE slow wave structure can be developed, a plasma electron heating method of wide application has been found. (auth) (UK)

34579 (N–68–10398) [AVCO EVERETT RESEARCH LABORATORY QUARTERLY PROGRESS REPORT, JUNE 24–SEPTEMBER 23, 1967]. (Avco-Everett Research Lab., Everett, Mass.). Oct. 1967. Contract NAS8-20310. 20p. (NASA-CR-89956). CFSTI.

Limits that constrain charge injections were studied in a toroidal experiment, and an analog tank was developed for possible use in evaluating the effects of differential geometrical arrangements for the plasma radiation shields and estimating the weights of full-scale shielding systems. An analytical demonstration was made of the existence of holes in electron clouds associated with the solenoid configuration, although the method used has limited practical value for the design of plasma radiation shielding. An apparatus for a planned high vacuum experiment is shown; and it is expected that this experiment will counteract the limited voltage, gain, and containment time in the present torus experiment. (STAR)

34580 (ORO-3458-11) ANOMALOUS DIFFUSION AND THERMALIZATION OF TURBULENT PLASMAS. Progress Report No. 3. (Texas Univ., Austin. Center for Plasma Physics and Thermonuclear Research). June 1968. Contract AT(40-1)-3458. 6p. Dep. CFSTI.

Brief summaries of work on the following are presented: (1) negative energy wave instabilities, (2) strong turbulence, (3) weak turbulence, (4) anomalous diffusion, (5) structure of oblique shock waves, and (6) field line trajectories in a Skornyakov trap. (M.O.W.)

34581 (SIT-2813-46) CROSS-FIELD PLASMA TRANSPORT IN A MAGNETICALLY CONFINED LOW-BETA COLLISION DOMINATED PLASMA. Courville, George E.; Rogers, Kenneth C. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). May 1968. Contract AT(30-1)-2813. 141p. Dep. CFSTI.

Measurements of plasma loss transverse to a uniform magnetic field were made with a potassium Q machine for the parameter range $2050 < T < 2350$°K, $10^{10} < n < 10^{11}$ cm^{-3} and $1000 < B < 4000$ gauss. Plasma losses were attributed to two mechanisms: M I, an E × B radial drift due to azimuthal temperature gradients at the hot ionizer plate, and M II, a wave-driven loss that has been identified as being due to a collisional drift-wave instability. Losses associated with M I can be expressed in terms of parameters by the empirical relation $\Gamma_1 = 3.8 \times 10^8 \nabla n/B^2$ cm^{-2} sec^{-1}, where ∇m is the density gradient (in cm^{-4}) and B is the magnetic field (in gauss). This loss, being related to the temperature gradient, is unavoidable (and would have a different numerical factor if the plate-plate heater geometry were altered) and represents a lower limit on the loss rate measurements. In the present work $\Gamma_1 \simeq 10\Gamma_c$ (Γ_c is the loss rate due to electron–ion collisional diffusion) which implies that the classical loss rate, Γ_c, could not be observed under the conditions of the experiment. The wave-driven loss rate, Γ_{II}, was correlated with oscillations through observation of simultaneous abrupt changes in oscillation mode—as predicted by drift wave theory—and in loss rate. The loss rate was found to vary as the square of the rms signal amplitude recorded by a floating Langmuir probe. Values of Γ_{II} were measured to $\simeq 100 \times 10^{12}$ cm^{-2} sec^{-1} which corresponds to about 3 times the value calculated using the Bohm diffusion coefficient. Γ_{II} was found to exhibit the parametric form $\Gamma_{II} \propto n\nabla n/B^6$, provided that the ionizer sheath potential is held fixed (i.e., constant input neutral flux and constant plate temperature). (auth)

34582 (TID-24491, pp 116-18) MINIMUM-B MIRROR MAGNETIC FIELD IN SYSTEM A. Herba, F.; Parker, R. R. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The minimum-B field is produced by discharging a 60-μF capacitor bank through a hexapole configuration, crowbarring the hexapole by means of an ignitron when the current is at a maximum. A brief description of the equipment operation is given. (M.O.W.)

34583 (TID-24491, pp 141-50) RADIATION DAMAGE IN THERMONUCLEAR REACTORS. Odette, G. R.; Ziebold, T. O. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Radiation damage calculations were made for 14-MeV neutrons (from D(T,n) α reactions) on copper and molybdenum. These were compared with experimental data. (M.O.W.)

34584 PLASMA ACCUMULATION BETWEEN A MIXED FIELD ACCELERATOR AND A PULSED MAGNETIC MIRROR. Brunet, Andre; Geller, Richard; Jacquot, Bernard (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 677-80(Mar. 11, 1968). (In French).

The qualitative results showing the energetic plasma accumulation between a structure of the Pleiade type functioning in continuous regime and a pulsed mirror are reported. (tr-auth)

Diagnostics of Plasma

Refer also to abstract 34272.

34585 (AD-660588) DENSITY PROFILE MEASUREMENTS. Final Report, June 1965–June 1967. Gloersen, P. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Sept. 1967. Contract AF49(638)-1578. 56p. (AFOSR-67-2364). CFSTI.

Plasma densities were measured in the exhaust stream of a repetitively fired coaxial plasma gun. Species in the exhaust were identified and their density and velocity profiles were obtained. The experimental results were compared with those anticipated on the basis of existing theoretical models. The results also were found to be in substantial agreement with conclusions reached from other measurements such as thrust, mass flow, and total energy in the exhaust stream. The measuring techniques that were involved were as follows: for the xenon neutral atoms, vacuum ultraviolet absorption spectroscopy; for the xenon ions (and also impurity ions), a Langmuir probe biased to collect ions; and for particle identification of luminous species in the exhaust, emission spectroscopy in the vuv region. The number density of the xenon ions turned out to be marginally low for optical detection and, furthermore, the background light source produced ion lines of sufficiently low intensity so that pulse-sampling would have been required to obtain the desired results. (auth) (USGRDR)

34586 (AD-662626) ARC PLASMA DIAGNOSTICS WITH VACUUM ULTRAVIOLET RADIATION. Final Report. Weissler, G. W. (California Univ., Los Angeles. Dept. of Physics). Aug. 1967. Contract AF33(615)-2395. 22p. (ARL-67-0178). CFSTI.

The purpose of this investigation was to study the emission and absorption properties in the vacuum ultraviolet region of the spectrum, between 200 A and 2000 A, of thermally stabilized cascade arcs. These arcs were operated at about 100 A and 60 V in either argon, neon, or helium at roughly one-third of an atmosphere of pressure. Rapid differential pumping was required at either end of the arc in order to allow vacuum ultraviolet radiation to pass from the arc into a 2 m radius of curvature grazing incidence grating vacuum spectrograph, or alternately to transmit through the arc plasma radiation from a separate light source. Emission and absorption work was limited to feasibility studies because of the long lead time in establishing an operating plasma arc. These studies proved highly promising, both with respect to vacuum uv emission from the arc and transmission through the arc. (auth) (USGRDR)

34587 (AD-665143) NON-LINEAR CORRECTIONS TO SPECTROSCOPIC TEMPERATURE MEASUREMENTS IN TURBULENT ARC PLASMAS. Final Report, January 1966–April 1967. Burns, Jay (Dearborn Observatory, Evanston, Ill.). Dec. 1967. Contract AF 33(615)-3355. 62p. (AFML-TR-67-371). CFSTI.

A detailed study was made of the statistical properties of short-time local temperature fluctuations in a turbulent arc plasma jet with temperatures ranging from 4000 to 7000K. The results of the study are given in the form of autocorrelation functions of temperature fluctuations at various locations in the plasma jet. Instantaneous temperatures were measured spectroscopically using violet CN band spectra and fluctuations could be determined on time scales as short as 1 to 2 microseconds. One objective of the study was to develop a relatively simple means of correcting the apparent temperature as measured by a slow integrating detector such as the photographic plate used in conventional spectroscopy to obtain the true average temperature obtained from time-resolved spectroscopic methods. A tentative method is proposed for evaluating the difference between apparent and true average temperatures in a turbulent plasma by an empirical relation between brightness fluctuations and temperature fluctuations that allows the latter to be inferred from measurements of the former which can be carried out with very simple equipment. (auth) (USGRDR)

34588 (AD-666475) ON THE APPLICATION OF SMALL-ANGLE ELECTRON SCATTERING TO PLASMA DIAGNOSTICS. Battle, E. L.; Marvin, A. L.; Bauer, A. A. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Mar. 1968. 23p. (AFIT-TR-68-4). CFSTI.

The scattering of an electron beam injected into a plasma is described by Moliere's theory of multiple collisions. Such a theory has the unique advantages of including multiple as well as single scattering, being quantum mechanically correct from the outset, and of being independent of the exact form of the differential scattering law provided only that it goes over to the Rutherford law for large angles. It is also explained how plasma diagnostics can be performed with such a technique in any of three scattering regions chosen to cover all possibilities of operation. Unavoidable finite-dimension effects inherent in any laboratory application are analyzed and shown not to negate the attractiveness or utility of the method. The uniqueness of the present method lies in its use of small-angle deflections to measure charged particle number density even in weakly ionized gases, as opposed to previous large angle methods useful for measuring the number of nuclei present regardless of the completeness of the atomic shells. (auth) (USGRDR)

34589 (CLM-R-81) CALCULATION OF PLASMA ELECTRON TEMPERATURE FROM ABSORPTION MEASUREMENTS OF CONTINUUM X-RADIATION FROM A PLASMA. Adlam, J. H.; Taylor, I. C. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Jan. 1968. 17p. Dep. CFSTI. UK 3s. 0d.

Two cases of continuum x radiation, (1) from the volume of a plasma, and (2) from a target placed in a plasma, are considered. The ratio by which the x-ray intensity is reduced on passing through an absorbing foil is a quantity which is readily measured. The organization of a computer calculation to obtain this ratio is discussed. Since the x-ray intensity was in practice measured by a scintillator and photomultiplier, the corrections due to the variation of scintillator efficiency with x-ray energy, which must be incorporated in the calculation, are discussed. (auth) (UK)

34590 (INR-P-883/XVIII/PP) MONOCHROMATOR MEASUREMENTS OF ION VELOCITIES IN A ROD PLASMA INJECTOR. Suckewer, S.; Kulinski, S.; Nowikowski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 20p. (CONF-680805-1). Dep.

For presentation at 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

The axial speeds of different group of ions were measured in a rod plasma injector with the aid of monochromator. The main result of these measurements was that the velocities of different groups of ions were practically equal. The average velocity of ions was about 5.5×10^6 cm/sec for delay time of gas supply $\tau = 60$ μs, and 3.5×10^6 cm/sec for $\tau = 240$ μs. It appeared also that all the groups of ions are mixed in a plasmoid and no ordered pattern exists concerning the distribution of ions in the plasmoid. The speed of the plasmoid was also estimated with the aid of ultrafast photography. A reasonably good agreement was observed between the velocities of ions and those of plasmoids. Results are discussed, along with the attempts made to find a suitable theoretical explanation of the results. (auth) (TSS)

34591 (RT/FI-(68)12) ANALISI ANALOGICA DELLA DISTRIBUZIONE RADIALE DELLA TEMPERATURA IN UN PLASMA JET AD INDUZIONE. (Analog Analysis of the Radial Temperature Distribution in an Inductive Plasma Jet). Cesaroni, C.; Malosti, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 61p. (In Italian). Dep.

The physical characteristics of argon vs temperature at atmospheric pressure are briefly described: electric and thermal conductivity, specific heat, and radiation. According to the hypotheses on thermodynamic balance and steady thermal flow, the system comprising the Maxwell equations, showing the trend of the electromagnetic quantities and the Fourier equation, describing the thermal balance, is solved with an analog computer. The results are followed by a critical analysis and compared with the existing literature. (tr-auth)

34592 (TID-24491, pp 43-5) ANISOTROPY OF THE ELECTRON VELOCITY DISTRIBUTION IN A REFLEX DISCHARGE MEASURED BY CONTINUOUS-WAVE LASER SCATTERING. Koons, H. C.; Fiocco, G. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The electron velocity distribution in a low-density reflex discharge in helium was measured by the scattering of Ar^+ laser radiation. (M.O.W.)

34593 (TID-24491, pp 99-109) CONTINUUM PROBE STUDIES OF A POSITIVE COLUMN IN FLOWING ARGON GAS. Garosi, G. A. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Experimental data were obtained from one or two electrostatic probes immersed in the plasma. Various density measurements are discussed. (M.O.W.)

34594 (TID-24491, pp 111-16) ION ENERGY ANALYSIS IN A BEAM-PLASMA DISCHARGE. Linford, R. K.; Smullin, L. D. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A study was made of the various diagnostic techniques for measuring ion energy distributions in the regime 0 to 100 eV. Results from measurements with a retarding potential analyzer are presented. (M.O.W.)

34595 NEW OPTICAL-SPECTROSCOPIC METHODS FOR THE MEASUREMENT OF PLASMA TEMPERATURE. Voros, T. Thesis.

New methods are given for the measurement of high temperatures which are based on the quadratic Stark effect shift and the broadening of the spectrum lines of plasmas. In high-temperature plasma, ions of various types (single, double, etc.) are found around the radiating atom. Their electric field shifts and broadens the radiated spectrum lines. The magnitude of shift $\Delta\nu$ and broadening $\Delta\gamma$ is related to plasma temperature T as follows:

$$\Delta\nu = aT^2\left[\exp - \left(\frac{b}{T}\right)\right]F(T) \qquad [1]$$

$$\Delta\gamma = a'T^{\frac{1}{2}}\left[\exp - \left(\frac{b'}{T}\right)\right]g(T) \qquad [2]$$

where a, b, a′, b′ are constants, F(T) and g(T) are temperature-dependent expressions. These equations make possible the determination of T after the measurement of $\Delta\nu$ or $\Delta\gamma$. The advantage of the method is that only one easily measurable quantity ($\Delta\nu$ or $\Delta\gamma$) is necessary for the determination of plasma temperature. However the equations [1] and [2] are so complicated that they cannot be solved for T in explicit form. Therefore, diagrams plotting $\Delta\nu$ or $\Delta\gamma$ as a function of T have been elaborated which in principle can be considered as a thermometer since, when measuring $\Delta\nu$ (or $\Delta\gamma$), the temperature can be read directly from the diagram. The application of the methods is given for Mg, Zn, Cd, Hg spark plasmas by the use of time-resolved spectroscope technique. The results show that the initial temperature of the discharge is ~50,000°K decreasing to ~10,000°K at the end of the discharge. (Hung. Tech. Abstr.)

34596 MEASUREMENT OF ELECTRON COLLISION FREQUENCY BY AN OPEN PLASMA RESONATOR. Akao, Yasuo; Ida, Yoshio (Nagoya Univ., Japan). Denki Gakkai Zasshi, 87-8: 101-5(Aug. 1967). (In Japanese).

It was shown that not only the electron density but also the electron collision frequency could be measured by (the Q characteristic of) an open plasma resonator. Comparing the method with that of a cavity resonator, the following features become apparent: (1) Whereas in the cavity-resonator method the electron density and collision frequency are obtained from changes of the resonance frequency and Q due to the plasma, in the plasma resonator method they can be directly measured from the resonance frequency and Q. The measuring apparatus and work thus become simple. (2) With a plasma resonator, measurements can be done at low frequencies, compared with the case of a cavity resonator. It therefore is useful for high-density plasmas. (NSA of Japan)

34597 LITHIUM PLASMA PRODUCED BY LASER GIANT PULSE. Tamura, Sanae (Japan Atomic Energy Research Inst., Tokyo); Mohri, Akihiro. Kakuyugo-Kenkyu, 20: 237-60 (Mar. 1968). (In Japanese).

Some properties of a plasma produced by a giant laser pulse focused on a surface of a metallic lithium target is investigated. Peak laser flux at the target is about 10^{12} W/cm^2. Measurements by double probes yield estimates of electron temperature of 3 eV and electron density of 10^{15} cm^{-3}. Time-of-flight analysis of double-probe signals shows that the plasma expansion of velocity corresponds to an ion kinetic energy of approximately 500 eV. Time-resolved photographs reveal that, although the plasma appears to expand roughly symmetrically about the original target position, a part of the plasma moves away from the target with a normal velocity to the target of about 5×10^6 cm/sec. When a uniform magnetic field (1000 to 5000 G) is applied parallel to the target surface, the plasma is found also to move away from the target, transversing the magnetic lines of force almost as rapidly as it does with no magnetic field. This phenomenon can be explained by the well-known $E \times B$ drift model of a plasma. An attempt is made to prove this model by short circuiting the polarization electric field with a conducting plate introduced near the midplane of the magnetic field. The plate is placed with its surface perpendicular to the magnetic field so that the polarization electric field may be short circuited along the lines of force. The motion of the plasma across the field almost completely disappears, while the motion along the lines of force becomes quite remarkable under these conditions. (NSA of Japan)

34598 STUDY OF THE EVOLUTION OF THE ELECTRON AND IONIC PROPERTIES OF A SUPERSONIC ARGON FLOW, IONIZED BY HIGH FREQUENCY INDUCTION. Dumousseau, Pierre (ESPCI., Paris). Compt. Rend., Ser. A and B, 266: 535-8(Feb. 26, 1968). (In French).

A lowering of the electron temperature was established at increasing inductive powers. The interpretation proposed takes into consideration multiple ionization phenomena and macroscopic exchange phenomena of the quantity of flow. The coupling between diffusion and recombination in volume in the equation of the evolution of electron density is shown. The variation of the Mach number is connected to the evolution of the electron parameters. (tr-auth)

34599 MEASUREMENT OF THE CHARGED PARTICLE DENSITY IN NONSTATIONARY PLASMA BY SHTARKOVSK BROADENING OF THE BALMER LINES H_β. Zagorodnikov, S. P.; Smolkin, G. E.; Sholin, G. V. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 224-31(Mar.-Apr. 1968). (In Russian).

A method for the measurement of the charged particle density of nonstationary plasmas by the Shtarkovsk broadening of the $H\beta$ lines is described. The ISP-51 spectrograph, combined with a Fabry-Perot interferometer, was used to obtain the line contours. The spectra of the nonstationary plasma were photographed by means of an electron optical converter with time scanning. The method makes it possible to measure the concentration of charged particles in the range from ~2×10^{13} up to ~3×10^{15} cm^{-3}. (tr-auth)

34600 LIMITS OF THE APPLICABILITY OF THE FOCUSED CONDUCTIVITY METHOD FOR PLASMA DIAGNOSTICS. Plyuta, V. E. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR, 12: 111-14(Feb. 1968). (In Russian).

The relations determining the limits of the values of the parameters of a cylindrical plasma during its measurements by focused conductivity are examined. The dependence of the parameter limits on the plasma diameter, dimensions of the wave guide, frequency of the electromagnetic field, and the potentials of measurement devices used for determination of the equivalent shunting conductivity, introducing the plasma to the waveguide, are shown. The results obtained are illustrated with numerical calculations for standard waveguides. It is shown that the focused conductivity method permits measurements in a strongly absorbing plasma. (tr-auth)

34601 COMPARISON OF SPECTROSCOPIC METHODS FOR DETERMINATION OF LOCAL TEMPERATURES IN A NITROGEN PLASMA JET. Clavin, Paul; Fauchais, Pierre; Manson, Numa (Faculte des Sciences, Vienne, France). Compt. Rend., Ser. A and B, 266: 834-7(Mar. 25, 1968). (In French).

The measurements of the temperature (from 8,000 to 16,000°K) in a nitrogen plasma jet, made by determining the enlargement of the Hβ line and the absolute intensity of the N I lines (4935 Å), and by establishing the Boltzmann atomic graphics of the N I lines, lead to results agreeing to ±5% and permit the evaluation of the transition probabilities of some lines of atomic nitrogen. (tr-auth)

34602 APPLICATION OF MICROCHEMICAL ANALYSIS TO DIAGNOSTICS OF LITHIUM PLASMA. Mohri, Akihiro (Kyoto Univ.); Tamura, Sanae. Kakuyugo-Kenkyu, 20: 261-70(Mar. 1968). (In Japanese).

A method for measuring the diffusion of a plasma produced from a metal of low vapor pressure with the aid of microchemical analysis is proposed. A pinholed cavity of a suitable material may be used as a complete sink of such a plasma stream: the plasma incoming through the pinhole will finally evaporate onto the inner surface of the cavity. The trace amount of the evaporated plasma is determined by flame photometry, the sensitivity of which is exceedingly high for alkali metals. This method is quite useful as a diagnostic technique especially for lithium plasma. Results are given on the application of this method to the E × B drift motion of a laser-produced lithium plasma across a uniform magnetic field. (NSA of Japan)

34603 ELECTRON SATURATION CURRENT IN A PLASMA IMMERSED IN A MAGNETIC FIELD IN THE DIRECTION OF DRIFT VELOCITY. Akazaki, Masanori; Watanabe, Yukio (Kyushu Univ., Japan). Kyushu Daigaku Kogaku Shuho, 40: 384-8(June 1967). (In Japanese).

The results of an experiment, taking into consideration the drift velocity due to an electric-field effect, with a disc probe having the plane normal to the magnetic field, are described. The following conclusion has been obtained: (1) The mechanism of electron collection to the probe may be approximated by the diffusion and drift to an effective, mean free path before the probe, and by a model, considering the drift velocity and assuming the Maxwell distribution, within an effective, mean free path of the probe. (2) Even if the drift velocity is fairly smaller than the thermal motion velocity, the decrease in the diffusion with the increasing magnetic field is considerable. And so, even for the comparatively weak magnetic field, the drift velocity and the diffusion velocity are nearly the same. It is thus possible to measure the drift velocity in the plasma, with a probe having the plane normal to the magnetic field. (NSA of Japan)

34604 SCATTERING OF MICROWAVES FROM A PLASMA COLUMN IN RECTANGULAR WAVEGUIDE. Ikegami, Hideo (Nagoya Univ., Japan). Jap. J. Appl. Phys., 7: 634-55(June 1968).

The microwave reflection method for the measurement of various parameters of cold plasma is examined. The exact solutions are obtained for the waves scattered by a plasma column inserted in the duct. The probing electric field of TE$_{10}$ mode is parallel to the axis of the column. The emphasis is placed on the fact that inhomogeneous electron density distribution is fully taken into account. The electron density in the column is assumed to be $n(r) = n_0(1 - r^2/\rho^2)$, where ρ is the radius of the column and n_0 is the electron density on the axis of the column. The electric permeability is then locally defined with use of n(r). Numerical calculations of reflection coefficients are carried out with the electronic computer OKITAC-5090 and their results are tabulated for such parameters as ω_p/ω, ν/ω, ka, and kρ for practical convenience. The electron densities in a positive column determined by the microwave reflection method with use of the tables are compared with those determined by the Langmuir probe method. The comparison is found in satisfactory agreement. (auth)

34605 BEHAVIORS OF ELECTROSTATIC CYLINDRICAL PROBE IN COMBUSTION PRODUCTS. Yanagi, Tetsui (Graduate School of Science and Engineering, Yokosuka, Japan). Jap. J. Appl. Phys., 7: 656-65(June 1968).

To establish the diagnostics of an electrostatic probe in the high-pressure plasma, the dependence of the probe characteristics on the probe length and temperature was experimentally investigated in the plasma of the combustion product by using a single-probe technique. The nearly linear dependence of the probe current on the probe length was observed to a fine and long probe, from which the effective probe length is determined to eliminate the end effect. By lowering the probe temperature from that of the ambient gas the probe current for a fixed voltage decreased. It was also ascertained, however, that the fine and long probe used in the combustion product can be regarded approximately as the probe which has the same temperature as the ambient gas and has no end effect. The dependence of the probe current on the probe temperature is explained by taking into consideration the thermal boundary layer surrounding the probe. (auth)

34606 SPECTROSCOPIC STUDIES OF THE DECAY OF HYDROGEN PLASMAS IN A T TUBE. Pavlov, M.; Prasad, A. N. (Univ. of Liverpool). Z. Phys., 212: 266-79(1968).

Spectroscopic studies were made of the decay of hydrogen plasmas generated in a relatively low-energy T tube of conventional design, equipped with a reflector. These measurements indicate that the plasma behind the reflected front is not quiescent, but suffers a severe expansion with flow velocities ~10^5 cm s^{-1} (velocities of the incident and the reflected front are 7×10^6 and 3.4×10^6 cm s^{-1}). The net energy loss during the first two microseconds of the decay is almost entirely due to radiative losses (principally Ly-α radiation) and no significant radial temperature gradients are observed. (auth)

34607 STARK BROADENING OF He II 3203 A. Ando, Koyo (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Soc. Jap., 24: 1366-70(June 1968).

The profiles of the ionic helium line, 3203 Å from a low-density and high-electron-temperature plasma which is formed in a low-pressure arc discharge chamber immersed in a magnetic field are investigated. The electron density of the plasma is about 8×10^{13}/cm^3 and the electron temperature is about 2×10^5°K. The red wing of the profile is found to be formed by the Stark broadening of ions and electrons. The electron densities are determined by the intensity of the red wing by using the theory of the Stark broadening of Griem and compared with the results of microwave interferometer and Langmuir probe measurements. (auth)

34608 APPLICABILITY OF THE LINE-REVERSAL METHOD IN MEASUREMENT OF ELECTRONS TEMPERATURE IN A WEAKLY IONIZED RARE GAS–ALKALI METAL PLASMA. Riedmueller, W.; Brederlow, G.; Salvat, M. (Institut fuer Plasmaphysik, Munich). Z. Naturforsch., 23a: 731-43(May 1968). (In German).

When an electric current is passed through a rare gas–alkali metal plasma the electron temperature rises above the gas temperature. This effect was investigated in a streaming argon–potassium plasma at atmospheric pressure and gas temperature of 2000°K. The applicability of the line-reversal method to the measurement of the electron temperature was investigated. General conditions under which the electron temperature equals the line-reversal temperature were derived. In the case studied, the plasma had to be optically thick for the resonance radiation used. The electron temperature was measured with this method as a function of the current density. The results are compared with the values calculated from theory and with the values calculated from the also-measured conductivities. For electron temperatures above 2400°K, all three give the same results. (auth)

34609 PHOTON COUNTING AS A TECHNIQUE FOR DETERMINING CORRELATIONS IN A PLASMA. Crosignani, B. (Istituto Superiore P. T., Rome); Di Porto, P.; Engelmann, F. Z. Naturforsch., 23a: 743-51(May 1968).

It has been suggested that counting photons scattered from a single-mode laser beam passing through a plasma may be used for determining correlations in the plasma. Higher-order moments of the distribution of photon counts are related to an ensemble average of higher-order products of the electric field. Hence, this method yields also information about higher-order correlations of the electron density fluctuations, in contrast with the measurement of the scattering cross section which depends only on second-order correlations. The connection between the statistics of photon counts and the properties of electron density fluctuations is discussed in detail, concentrating on the first and second moment of the photon count distribution. The incident wave is assumed to be plane and ideally monochromatic. For stable plasmas in a steady state, the results are written in terms of the distribution functions of the electron and ion velocities. Weakly turbulent unstable plasmas in the phase of exponential growth are also considered, using as a characteristic parameter the spectrum of the electric micro field. (auth)

34610 PLASMA DIAGNOSTICS WITH A MICROWAVE FABRY-PEROT RESONATOR. **Chaffin, Roger J. (Sandia Corp., Albuquerque, N. Mex.); Beyer, James B. Contract AT(11-1)-1233. IEEE (Inst. Elec. Electron. Eng.) Trans. Microwave Theory Tech., MTT-16: 37-45(Jan. 1968).**

Plasma diagnostics with a confocal spherical mirror Fabry–Perot resonator are examined. The diagnostic equations are presented and experimentally verified. The measurable ranges of electron densities and collision frequencies are treated both theoretically and by example. A brief background of the theory of the resonator is summarized (with references) from the literature. A perturbational technique for measuring collision frequency, or Q change, through the variation of a resonator's transmission coefficient at resonance (for a general resonator) is derived, and the results experimentally verified. This technique could be a powerful diagnostic tool and is shown to have certain advantages under noisy conditions. This type of resonator is simple and inexpensive to construct, easy to align, and gives very good diagnostic results. In an appendix by use of perturbation theory, a relation between the change in Q and the change in the transmission coefficient for any general cavity, not necessarily a Fabry–Perot resonator, is derived. (BBB)

34611 UTILIZATION OF LASERS FOR THE DIAGNOSIS OF PLASMAS. **Benoit-Cattin, P. (Centre de Physique Atomique et Nucleaire, Toulouse); Verdier, Pierre. Ind. At., 12: No. 3-4, 75-82(1968). (In French).**

The various known methods of diagnosing plasmas by means of luminous beams are reviewed. These methods offer the advantage of only slightly disturbing the media under study, but their sensitivity is poor, and they only permit the study of plasmas of very concentrated densities (in general those greater than 10^{19} e/m^3). Thanks to the extreme cohesiveness of the radiation emitted and to the possibility of producing rays of considerable potencies, the lasers have made it possible to work out a significant development of these methods. (auth)

34612 ELECTRON DENSITY MEASUREMENTS OF PLASMA JET BY MICROWAVE INTERFEROMETRY. **Kamimoto, Goro (Kyoto Univ.); Horiuchi, Nozomu. Nippon Koku Gakkaishi, 16: No. 170, 67-74(Mar. 1968). (In Japanese).**

The electron number density obtained in the center of the flow was in the range from 10^{12} to 10^{13}/cm^3 for argon and from 10^{11} to 10^{12}/cm^3 for nitrogen. The former agreed with the results of the Langmuir probe measurements. The phase shift, $\Delta\phi$, of the microwave through the plasma due to the existence of a transient plasma is usually obtained from the output variation of the microwave interferometer, which is called a fringe. In this experiment it was obtained from the direct measurements of the microwave power passed through each arm of the interferometer as well as the interferometer output. Some discussions were given in order to determine the sign and the integer part of it. The interception plate was also used to cut off the flow during the run. (NSA of Japan)

34613 MEASUREMENT OF THE FARADAY ROTATION OF A LASER BEAM PASSING THROUGH A θ-PINCH PLASMA. Falconer, I. S.; Ramsden, S. A. (National Research Council of Canada, Ottawa). J. Appl. Phys., 39: 3449-58(June 1968).

Faraday rotation of a beam of light is discussed as a means of determining the magnetic field within a plasma and the relative merits of various detection systems are considered. Apparatus is described for measuring the rotation of the plane of polarization of a He–Ne laser beam at 6328 Å on passing through a small θ-pinch plasma. Using a differential detection system of risetime 0.3 μsec, an observed peak rotation of 1.0 mrad can be measured to an accuracy of 10%. Deviation of the beam by electron-density gradients within the plasma is shown to be small and readily compensated for. Good agreement is obtained between the measurements of Faraday rotation and independent measurements of the magnetic field using magnetic probes (auth)

34614 REFLECTION TECHNIQUE FOR PLASMA-DENSITY MEASUREMENT. **Bruce, R. L.; Crawford, F. W.; Harp, R. S. (Stanford Univ., Calif.). J. Appl. Phys., 39: 3349-54(June 1968).**

A microwave bridge technique is described in which the reflection from a discharge column placed transversely across a waveguide is measured and used to derive the plasma electron density. A first-order perturbation theory for the reflection has been checked by measurements on calibrated dielectric rods and is used to obtain number density data for comparison with independent measurements made by cavity-perturbation and dipole-resonance techniques. The method seems to be capable of giving less than 30% error and has the advantage that it is particularly well suited to time-resolved electron-density measurements. As an example, typical data are presented for the decay of an afterglow plasma in a magnetic field. (auth)

34615 ION CURRENT TO A LANGMUIR PROBE IN VERY-LOW-DENSITY FLOWING PLASMAS FOR ELECTRON-DENSITY DETERMINATIONS. **Chen, Sin-li; Goodings, J. M. (York Univ., Toronto). J. Appl. Phys., 39: 3300-5(June 1968).**

The mechanism for ion-current collection by Langmuir probes and the validity of electron-density determinations using ion-current characteristics are examined for low-density ($N_e = 10^9$ to 10^5 cm^{-3}) flowing plasmas in various gases (He, Ar, N_2, and air) for the pressure range 0.05 to 1 torr. When $h \gg r_p$ (where h = electron Debye length, and r_p = probe radius), both cylindrical and ring probes show spherical-probe behavior; the experimental ion current I_i varies almost linearly with the probe voltage V_p. The results are compared with Su and Lam's collision-dominated theory. Experimental ratios of the electron to the ion current I_e/I_i agree with those predicted by the plasma "sheath criterion" for $N_e > 10^8$ cm^{-3}. But for $N_e < 10^6$ cm^{-3}, I_i increases so that I_e/I_i is low by an order of magnitude, and I_i cannot be used for N_e determinations. Explanations are offered in terms of the method used to evaluate the ion current, interference of the discharge-tube wall, and, at higher pressure, the release of electrons from the probe surface by collisions of metastables (or photons). (auth)

34616 ION TEMPERATURE, CHARGE EXCHANGE, AND COULOMB COLLISIONS IN AN ARGON PLASMA COLUMN. **Hudis, Martin; Chung, K.; Rose, D. J. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 39: 3297-9(June 1968).**

Ion temperatures in a highly ionized argon plasma column have been measured with a Fabry–Perot interferometer. Plasma-column conditions were altered over a range of parameters from 10% to 70% ionized, electron temperature T_e = 2 to 10 eV, and magnetic field 1400 to 2800 G. In general, T_i is about one-tenth T_e, determined by the balance between electron heating and charge-exchange cooling. The measured values of T_i agree fairly well with those calculated, using accepted values of Coulomb collision and charge-exchange cross sections. Alternately, the present data are processed to derive approximate values of the charge-exchange cross section to neutral argon as a function of Ar^+ ion energy in the range 0.1 to 1.0 eV. It can also be concluded that the theoretical rate for electron–ion energy relaxation is not seriously in error. (auth)

34617 MICROWAVE MEASUREMENT OF THE ELECTRON-DENSITY PROFILE IN A MERCURY PLASMA. **Carlile, R. N.; Swinford, H. W. (Univ. of Arizona, Tucson). J. Appl. Phys., 39: 3268-73(June 1968).**

An experimental method is described which permits the electron-density profile in a circular cylindrical plasma column in the absence of a magnetic field to be measured. The method involves the propagation of plasma surface waves. Two parameters which characterize the profile are determined: α, the parabolic rate of decrease of electron density from the system axis, and T, which is a measure of the plasma-sheath thickness. For our experimental system in which the plasma is the positive column of a mercury-vapor dc discharge we find $\alpha = 0.76 \pm 0.07$ and $T = 0.96 \pm 0.03$. (The plasma-sheath thickness is $1 - T$ times the discharge radius.) These results are in good agreement with Parker's theoretical prediction. (auth)

34618 PLASMA DIAGNOSTICS BY MEANS OF HALL CURRENT. **Nagata, M. (Meiji Univ., Japan). Elec. Eng. Jap. (Engl. Transl.), 86: 40-50(Aug. 1966).**

Plasma electron density measured by the probe technique would tend to be less than the actual density. In the Hall-current measurement technique, the effect of the transition layer immediately adjacent to the probe surface can be made much smaller. The Hall current between the two parallel plane short-circuited probes can be detected even with a simple circuit. For a more accurate measurement of the Hall current, a more sophisticated circuit was designed. Using this circuit the following characteristics were observed: a linear relation between I_h and B; similarity between dependence of I_{p2} on V_{p2} and that of I_h on V_{p2}; shift in the I_h curve with changing V_x. These results agree with expected results, and, therefore, the measurement technique is reliable. The effect of the transition layer on the Hall current was also investigated to show that I_h and τ have similar relations with P. The ratio N_O/n_p and its variation with P were also shown to be in agreement with qualitative predictions. The effect of the transition layer on the Hall current is negligibly small. Because the Hall voltage and the Hall current obtained in these experiments were very small quantities, the effects of the magnetic field on the conditions of the discharge were assumed to be negligible. The linear relation between I_h and B observed experimentally is an important result from this viewpoint. The measurement technique reported may be useful as a method for measuring the plasma density in the magnetic field. (BBB)

34619 SPECTROMETRIC STUDIES OF ARGON PLASMAS. **Raso, G.; Diana, M.; D'Alessio, A. (Univ., Naples). Chim. Ind. (Milan), 50: 63-70(Jan. 1968). (In Italian).**

Streams of Ar plasmas at atmospheric pressure were studied spectrometrically after production by means of a wall-stabilized arc 10 mm ID and 96 mm long. Radial temperature distributions were determined at different power input by the use of line intensities, comparing the lines with each other and with the continuum. Ratios of intensities of the 4300 Å and the 4806 Å lines are plotted between 9000°K and 15,000°K. Data are compared with theoretical predictions. Agreements between the different comparison methods range from ca. 50° to 300° in different regions of the plasma. A correlation chart of temperature error as a function of error in the ratio of emission intensities is constructed; data are also discussed in terms of the physical chemical theory of the state of the system. (BBB)

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Refer also to abstract 34145.

34620 (AD-660571) ELECTRICAL CONDUCTION FROM A LAMINAR ARC HEATED FLOW TO A COOLED CYLINDRICAL ANODE. Final Report. Runstadler, P. W. Jr. (Dartmouth Coll., Hanover, N. H.). July 1967. Contract AF33(657)-8179. 88p. (ARL-67-0142). CFSTI.

Electrical conduction in an arc-heated atmospheric-pressure plasma flow passing through a ring anode was investigated. The arc plasma flow is maintained in a tube between an upstream cathode and an anode at the tube exit. A "test" ring anode upstream of the primary anode is biased relative to its floating potential permitting current to be drawn to the flowing plasma. Anode characteristics were measured for helium and argon in a 1-cm duct at atmospheric pressure. Experiments included copper, nickel, molybdenum, silver, magnesium, tungsten, aluminum, and iron as anode materials. Electrical conduction to the anode is found to be a function of arc gas type, main arc current, anode material, and anode geometry for a fully developed flow in a fixed tube size. Electrical conduction is strongly dependent upon the cleanliness of the apparatus. At low bias currents, electrical conduction tends to be uniformly distributed over the anode surface in the circumferential direction. At higher levels of bias current, nonuniform electrical conduction distributed over a small surface area (anode spots) usually occurs. A theory was developed for conduction in helium for low bias currents. (auth) (USGRDR)

34621 (AD-660576) EXPERIMENTAL MEASUREMENT OF THE EMISSION AND ABSORPTION OF RADIATION BY AN ARGON PLASMA. Evans, D. L.; Tankin, R. S. (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). July 1967. Contract AF33(615)-1160. 141p. (ARL-67-0157). CFSTI.

A thermistor bolometer was used to obtain spatially resolved measurements of the total radiation of an argon plasma in the spectral ranges of 0.2 to 3.5 μ and 0.2 to 22 μ. The measurements were correlated with temperature at pressures of 0.5, 1.0 and 2.0 atm. The use of a free-burning arc as a source allowed measurements at temperatures from 10,000 to 26,000°K. Spectroscopic measurements and the well-known Fowler–Milne technique were used to determine the temperature. For the one-atmosphere case, absorption measurements were made so that the emission results could be corrected for absorption. Corrections for the ultraviolet radiation were also made and results are compared with existing theories and data. Measured values agree well with those made by Avco while corrected values are close to those of Emmons. The 6965.43 ArI line was also studied. Line shifts, ½-halfwidths, absorption coefficients, and emission coefficients were measured. Transition probabilities from both emission and absorption studies are found to be in agreement. The value obtained is within the experimental error of Olsen. (auth) (USGRDR)

34622 (AD-660809) ELECTRICAL CONDUCTIVITY OF MAGNETOPLASMAS. PART I. GENERAL THEORY OF EFFECTIVE PARAMETERS. Physical Sciences Research Papers No. 342. Bakshi, P. M.; Haskell, R. E.; Papa, R. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Sept. 1967. 32p. (AFCRL-67-0527). CFSTI.

The use of effective parameters to take into account the velocity dependence of the electron–neutral collision frequency is reviewed. The concept of an effective collision frequency and an effective plasma frequency is applied to wave propagation in weakly ionized magnetoplasmas. The relation between these effective parameters and a new collisional response function R(y) is described. Curves are presented of the effective parameters as a function of frequency for both a pure power law dependence of the collision frequency on electron velocity and for the case of a coupling between two power law variations. The isotropic part of the electron distribution is taken to be Maxwellian. (auth) (USGRDR)

34623 (AD-660810) ELECTRICAL CONDUCTIVITY OF MAGNETOPLASMAS. PART II. EFFECTIVE PARAMETERS FOR NON-MAXWELLIAN DISTRIBUTIONS. Physical Sciences Research Papers No. 343. Haskell, R. E.; Papa, R. J.; Bakshi, P. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Sept. 1967. 29p. (AFCRL-67-0528). CFSTI.

For a magnetoplasma in a strong ac electric field, it is possible to derive an expression for the isotropic part of the electron distribution function that depends upon the polarization and intensity of the ac field. In Part I (AD-660,809), it was shown how the applicability of a constant-collision-frequency model of wave propagation in magnetoplasmas may be extended to include velocity-dependent collisions by introducing an effective collision frequency and an effective plasma frequency. In addition to being functions of signal frequency and the type of power law dependence of the collision frequency on electron velocity, the effective plasma parameters are now also functions of the ellipticity and intensity of the ac field, since these effective parameters depend upon the form of the electron distribution function. Curves are presented of the effective parameters as a function of normalized frequency, normalized field strength, and dependence of collision frequency on electron velocity for the case where only pure (unmixed) modes are present in the magnetoplasma. (auth) (USGRDR)

34624 (AD-661073) EXPERIMENTAL INVESTIGATION OF THE LOW-VOLTAGE ARC IN NOBLE GASES. Final Report (Part 4), June 1, 1963–December 31, 1966. Martin, R. J. (Michigan Univ., Ann Arbor. Electron Physics Lab.). June 1967. Contract DA-36-039-AMC-02269(E). 202p. (TR-101; ECOM-02269-F4). CFSTI.

The low-voltage arc mode of the hot-cathode discharge in noble gases was studied experimentally in planar geometry by means of guard-ringed Langmuir probes. Measurements show that if there is ample electron emission from the hot cathode, two stable high-current, low-voltage discharge modes exist in the noble gases; these are the low-voltage arc and the ball-of-fire mode. Neither mode is obtained in hydrogen. Measurements of the steady-state characteristics of the low-voltage arc were made predominantly in neon; xenon and argon were also investigated. The peak plasma potentials measured within the low-voltage arc were approximately 14, 6, and 4.5 volts for neon, argon and xenon, respectively. Measurements on the hot-cathode discharge in neon with small admixtures of hydrogen indicate that cumulative ionization is important for the generation of the low-voltage arc. The study of the effect of a Penning impurity upon the low-voltage arc indicates that less than 0.06% by volume of the Penning impurity affects the discharge plasma. (auth) (USGRDR)

34625 (AD-661304) LOW-VOLTAGE ARC STUDIES. PART V. Final Report No. 12, June 1, 1963–December 31, 1966. Lomax, R. J.; Martin, R. J.; Rowe, J. E.; Salinger, S. N. (Michigan Univ., Ann Arbor. Electron Physics Lab.). June 1967. Contract DA-36-039-AMC-02269(E). 110p. (ECOM-02269-F5). CFSTI.

A summary of the first four parts of the Final Report is presented. In Parts I, II, and III, analytical models are developed to study various aspects of the behavior of plasmas such as are present in the low-voltage arc. The approach in Part I is based on the transport equation and concentrates on the time-dependent behavior of the plasma. In Part II a ballistic model is used and the existence and propagation of waves in the plasma are investigated. Such waves arising from plasma oscillations are normally present in gas discharges and probably play an important part in energy exchange. Part III describes a Monte Carlo simulation of the low-voltage arc which incorporates many effects such as inelastic collisions which are virtually impossible to include in any other form of mathematical model. A detailed experimental investigation of the low-voltage arc in noble gases is described in Part IV, some results of which are used in Part III. Measurements were made in neon, xenon, and argon of the potential distribution, electron density distribution and electron temperature. Cumulative ionization was investigated by introducing a small amount of hydrogen. The results indicate that this is an important mechanism. Some measurements were made on the effect of impurities which indicate that impurity effects were negligible in all of the other measurements. (auth) (USGRDR)

34626 (AD-661805) ELECTRON DENSITY OF AIR BEHIND A REFLECTED SHOCK WAVE. Aronson, Philip N.; Levine, David (Naval Ordnance Lab., White Oak, Md.). Jan. 5, 1967. 18p. (NOLTR-67-139). CFSTI.

The electron density of air in the region behind a reflected shock wave was studied experimentally and compared with values obtained from thermodynamic calculations. The measurement of electron density was made with a microwave system which monitored the power transmitted through the plasma. Measured values of electron density were found to be higher than those predicted from thermodynamic considerations. (auth) (USGRDR)

34627 (AD-662346) TURBULENT EDDIES IN HIGH-DENSITY SPARK CHANNELS IN HELIUM. Physical Sciences Research Papers No. 344. Fischer, Heinz; Schonbach, Karlheinz (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Sept. 1967. 16p. (AFCRL-67-0544). CFSTI.

Turbulent eddies in high-pressure microsecond spark channels in helium were photographed by means of a 20-nsec Kerr-cell shutter. Current densities exceeded 1,000,000 A/sq. cm. It was shown that turbulences are initiated from plasma jets originating at the electrodes. The cathode jet is explained by Compton's accommodation theory which was extended by Haynes. The observed anode shock wave appears to be the result of a dynamic magnetic pinch. (auth) (USGRDR)

34628 (AD-662904) ELECTRICAL CONDUCTIVITY OF A RELATIVISTIC PLASMA. Kelly, Don (Yale Univ., New Haven, Conn.). 1967. Contract Nonr-609(51). 11p. CFSTI.

One aspect of plasma kinetic theory is extended to include relativistic effects. Specifically, relativistic modifications of the electrical conductivity are studied, using a covariant form of the Boltzmann equation. The electrons are assumed to undergo Coulomb collisions with the ions. Electron—electron collisions and Compton scattering are ignored. The dynamic effects produced by an external magnetic field are included, but the important modifications resulting from cyclotron emission are neglected. The plasma is assumed to be tenuous so that collective effects are ignorable. (auth) (USGRDR)

34629 (AD-662906) LOCALLY MAXWELLIAN DISTRIBUTIONS IN A RELATIVISTIC GAS. Kelly, Don (Yale Univ., New Haven, Conn.). 1967. Contract Nonr-609(51). 21p. CFSTI.

The possible types of local Maxwellian distributions are determined for a relativistic gas. In the absence of external forces the number of free parameters is eleven, a reduction by two from the number obtained for the nonrelativistic case. The close correspondence of the relativistic and nonrelativistic solution reveals which two parameters must be zero. Severe restrictions also are placed on the possible types of forces which are consistent with local equilibrium and the requirements of special relativity. Special attention is directed to the local equilibria open to a gas of charged particles subject to an electromagnetic field. An explicit solution is obtained for the distribution function of such a gas when the fields are constant. (auth) (USGRDR)

34630 (AD-662909) MICROWAVE HARMONICS IN A PLASMA: A SURVEY. Kelly, Don (Yale Univ., New Haven, Conn.). 1967. Contract Nonr-609(51). 20p. CFSTI.

The report surveys the experimental and theoretical papers concerned with microwave harmonics in plasmas. The two central problems which command most of the attention are (1) the development of coherent sources of millimeter power, and (2) harmonic effects on the propagation of electromagnetic waves through plasmas. (USGRDR)

34631 (AD-662910) STATISTICAL THEORY OF EMISSION, ABSORPTION, AND CONDUCTIVITY OF RADIATION IN FULLY IONIZED PLASMAS. Kim, Dae Mann (Yale Univ., New Haven, Conn.). 1967. Contract Nonr-609(51). 26p. CFSTI.

Kinetic equations for the time evolution of the radiation modes in fully ionized plasmas with steady electron and ion distributions are derived. The work results in formulas for emission, absorption, and conductivity which include the collective behavior of the plasma. (auth) (USGRDR)

34632 (AD-663212) EXPERIMENTAL INVESTIGATIONS OF NORMAL IONIZING SHOCK WAVES. Levine, Leslie S. (Columbia Univ., New York. Plasma Lab.). 1967. Contract AF49(638)-1634. 162p. (AFOSR-68-0023). CFSTI.

Experiments were conducted on normal ionizing shock waves produced in a coaxial electromagnetic shock tube. Steady shock velocities were measured as a function of initial gas pressure, drive current, and applied axial magnetic field. The speeds agreed well with theoretical values. Shocks propagating at trans-Alfvenic speeds were studied. Measurements were made of the upstream transverse electric field and the switch-on magnetic field. Further support for this theory was provided by the measured compression ratio across the shock front. It was concluded that trans-Alfvenic normal ionizing shocks exhibited Chapman—Jouquet behavior with current flow in the shock front, and no separation of shock and drive currents. In contrast, super-Alfvenic shocks appear to be gasdynamic in nature. Spectroscopic measurements and shock reflection studies demonstrated the presence of a nonluminous front and shock heated gas preceding the drive current. The luminosity front acts as a contact surface separating the unequilibrated shock from the luminous current. Finite transverse electric fields and switch-on behavior were observed at super-Alfvenic shock speeds. Both of these effects were attributed to the finite conductivity of the plasma. (auth) (USGRDR)

34633 (AD-663218) INVESTIGATIONS ON ANODE FALL MECHANISMS. Final Report. Hoecker, K. H.; Bez, W.; Mayser, B.; Schrade, H. (Technische Hochschule, Stuttgart (West Germany)). Feb. 15, 1959. Contract AF61(052)-34. 135p. CFSTI.

The investigations are a first venture in attempting a theory of the thermal anode fall. The first section deals with the quantitative calculation of the anode fall of the Beck arc in dependence on the current. In past literature, the discussion of the anode fall of Beck arcs has been of a qualitative nature, based on a thermal mechanism. It is shown that within the anode fall region proper, which is responsible for the production of carriers, one does not find a thermal but a field ionization mechanism. However, proceeding from the anode to the column a thermal heating of a plasma jet occurs. A general system of equations for the pure thermal anode fall mechanism is established. Several possibilities are compared. The kinetics of electrons and ions in a fully ionized plasma are discussed. In an extension to presently known publications, this study considers relative drift motion and temperature differences among plasma components, thus presenting a calculation of frictional force and heat exchange. (auth) (USGRDR)

34634 (AD-664053) HIGH-FREQUENCY BREAKDOWN OF NONUNIFORM GASES IN SPATIALLY VARYING FIELDS. Epstein, Melvin (Aerospace Corp., El Segundo, Calif.). Nov. 1967. Contract F04695-67-C-0158. 25p. (TR-0158(3240-20)-5; SAMSO-TR-67-116). CFSTI.

A method is described for predicting the field strength required to produce cw breakdown of gases with spatially varying properties subjected to electric fields of nonuniform intensity. The proposed method is based on a variational principle derived from the electron continuity equation. A Ritz method is used to generate solutions of the variational problem. The approximate solutions are evaluated by comparing them with several exact solutions which are also developed in this paper. The use of a one-term trial function in the Ritz method is found to give very good agreement with the exact solutions. A two-term approximation provides greater accuracy than is presently available from experimental data. (auth) (USGRDR)

34635 (AD-665142) LOSSES IN PLASMA ACCELERATION. Annual Technical Report. Ducati, Adriano C. (Giannini Scientific Corp., Santa Ana, Calif.). Nov. 1967. Contract AF49-(638)-1743. 111p. (AFOSR-68-0004). CFSTI.

A study of the vacuum tank environment of an MPD arc jet was initiated by means of static and impact pressure measurements and by measurement of heat flux to calorimeter slugs distributed within the tank, in order to obtain an understanding of conditions which lead to environmental interference. The measurement of heat flux to calorimeter slugs placed at different axial positions near the tank walls shows that the distribution of the radial heat flow from the exhaust jet reaches a maximum about ten inches from the anode face and is nearly independent of power and magnetic field strength. (USGRDR)

34636 (AD-665527) EXCITATION OF LOW-FREQUENCY OSCILLATIONS AT UPPER HYBRID RESONANCE MICROWAVES. Hiroe, S.; Ikegami, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov. 1967. 12p. (IPPJ-60). CFSTI.

Low-frequency oscillations are excited by microwaves at the upper hybrid resonance in the presence of dc magnetic field. The low frequency (f) satisfies a simple relation, (fci/f)2 + (fpi/f)2 = 1, which is known as the lower hybrid resonance. There is a threshold power for the microwave to excite the oscillations. It is expected that the lower hybrid mode in plasmas is coupled with the Bernstein mode at the upper hybrid resonance through a strong nonlinear process. (auth) (USGRDR)

34637 (AD-665529) PROPAGATION AND DAMPING OF LARGE-AMPLITUDE ION ACOUSTIC WAVES IN A PLASMA. Sato, Noriyoshi; Ikezi, Hiroyuki; Takahashi, Nobuo; Yamashita, Yoshihiko; Obiki, Tokuhiro (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov. 1967. 10p. (IPPJ-62). CFSTI.

Finite amplitude effects on propagation and damping of ion acoustic waves are studied experimentally in a cesium plasma produced by surface ionization. For large-amplitude waves, the phase velocity is increased with the voltage of continuous sinusoidal signals for wave excitation, but does not depend on the local wave amplitude. The damping rate becomes large with the exciting voltage near the exciting grid. At a distant place, however, the wave damping is small compared with the linear Landau damping and is accompanied with a weak-amplitude oscillation. (auth) (USGRDR)

34638 (AD-665826) SPATIAL RESOLUTION OF EMISSION AND ABSORPTION COEFFICIENTS IN SELF-ABSORBING SOURCES OF CYLINDRICAL SYMMETRY. Birkeland, Jorgen W.; Oss, John P. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Dec. 1967. 40p. (ARL-67-0279). CFSTI.

An iteration technique for obtaining the radial profiles of emission and absorption coefficients in self-absorbing sources of cylindrical symmetry, and a numerical method for applying the techniques to experimental data is given. The iteration technique, involving a series of integrations and Abel inversions, is formally derived, and an IBM 7094 FORTRAN IV program for performing the calculations is listed. (auth) (USGRDR)

34639 (AD-665886) NEGATIVE CYCLOTRON RESONANCE ABSORPTION. Final Report, March 15, 1965–March 15, 1967. Wachtel, Jonathan M. (Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science). Aug. 25, 1967. Contract AF19(628)-5104. 110p. (AFCRL-67-0497). CFSTI.

The kinetic theory of waves in an infinite plasma in a uniform, constant magnetic field predicts that radiation near the cyclotron frequency in a sufficiently nonthermal plasma may grow in time. One effect which can cause such growth or negative cyclotron resonance absorption of radiation which propagates perpendicular to the magnetic field direction is the relativistic energy dependence of the electron's mass. Another is the energy dependence of the electron–atom collision cross section for low-energy electrons in a neutral gas background. The cyclotron resonance absorption of microwave energy by monoenergetic electrons which drift through a cavity resonator has been measured in order to verify these predictions. In each case the observed absorption spectra are similar to those calculated in a perturbation theoretical solution of the Boltzmann equation treating the cyclotron resonance interaction between the electron beam and the bounded standing wave fields of the cavity resonator. An experiment which exhibits the radiative response in time of a weakly relativistic, monoenergetic electron ensemble to a short pulse of cyclotron resonance radiation is also described. The radiation calculated in an exact solution of the Boltzmann equation is found to occur in repetitive bursts of diminishing amplitude following the stimulating pulse. Experiment and theory are observed to be in qualitative agreement. (auth) (USGRDR)

34640 (AD-665895) DESIGN AND EVALUATION OF A RADIO FREQUENCY PLASMA SOURCE. PART I. SELF-EXCITED OSCILLATOR. Boedeker, L. R.; Coffin, J. B. Jr.; Covert, E. E.; Haldeman, C. W. (Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.). Dec. 1967. Contract AF33(615)-2790. 196p. (TR-133; ARL-67-0281(Pt.1)). CFSTI.

The design, construction, and performance of a very high rf discharge plasma source are discussed. The purpose of such a device in the present research program is to provide a source of nonequilibrium air plasma of suitable electric conductivity for the operation of the traveling-wave pump, an electrodeless induction plasma accelerator. The final accelerated plasma stream is sought as a flow facility for high-altitude high-Mach-number flight simulation. A study of the plasma stream effluent from the source is made and electron energy distributions and electron density profiles are presented as a function of operating power input and pressure. The electric conductivity of the plasma and the wall energy losses are also measured. At the lowest pressure of operation (35 millitorrs) the ratio of electron temperature to gas temperature is found to be over 200 at the point of highest gas temperature. The electrical circuits for generating the rf energy and for diagnostics measurements are also discussed. (auth) (USGRDR)

34641 (AD-666665) MEASUREMENT OF THE REFRACTIVE INDEX IN AN ARGON PLASMA AT 6328A AND 1.15 MICRONS. Final Technical Report. Hug, W. F.; Tankin, R. S.; Cambel, A. B. (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). Dec. 1967. Contract AF33(615)-1160. 172p. (ARL-67-0218). CFSTI.

The refractive index was measured at wavelengths of 6328 A and 1.15 μ in an argon plasma produced by a dc electric arc. The refractive index was correlated with temperatures determined from atomic line and continuum emission coefficient measurements. The experimental results were compared with simple dispersion theory which considers contributions from ground-state atoms and free electrons. (auth) (USGRDR)

34642 (AD-666946) STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS. Final Report, November 30, 1964–November 30, 1967. Oskam, H. J. (Minnesota Univ., Minneapolis. Dept. of Electrical Engineering). Jan. 1968. Contract AF19-(628)-4794. 23p. (AFCRL-68-0072). CFSTI.

Results obtained from studying the mobility of ions and the properties of decaying plasmas are summarized. The measuring method consisted of the simultaneous application of pulse techniques and mass and light spectrometer techniques. The plasmas studied were produced in helium, neon, nitrogen, helium-neon mixtures, and helium–nitrogen mixtures. Long-existing discrepancies in the explanation of the origin of the afterglow light emission were resolved in helium and neon. Information about electron–ion recombination processes was obtained. The same was possible with respect to the mobility of positive ions in their parent gas. The studies performed on nitrogen afterglows resulted in establishing the production of N_2^+ ions by mutual collisions between metastable molecules. A theory and method for determining the catalytic efficiency of a surface for recombination of nitrogen atoms were developed. (auth) (USGRDR)

34643 (AD-666970) INVESTIGATIONS OF IONIC SPECIES IN HIGH-PRESSURE CESIUM DISCHARGES. Annual Report, March 1, 1967–February 29, 1968. Chanin, Lorne M. (Minnesota Univ., Minneapolis. Inst. of Tech.). Contract N00014-67-A-0113-002. 44p. CFSTI.

Measurements are reported of ion species present in active rf and dc plasmas of argon and cesium. Comparison is made of data obtained using ion extraction through the anode and cathode of a dc plasma with measurements made using rf excitation of the plasma. (auth) (USGRDR)

34644 (LFEN-NI.-28a) PRIMEIRA INSTALACAO DO L.F.E.N. PARA A INVESTIGACAO DE ONDAS E RESSONANCIA IONICO-CICLOTRONICAS NO PLASMA. (First Installation of LFEN for the Investigation of Resonance Cyclotron Moves in Plasma). Rosa, Rui Namorado; Rodrigues, Fernando Godinho (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1965. 21p. (In Portuguese). Dep.

A theory on the cyclotron resonance and the conditions for the propagation of different types of plasma waves is introduced. The experimental installation, consisting of units producing the magnetic field and the plasma, together with the control system, radiofrequency generators, and observation and measurement devices, is described. (tr-auth)

34645 (N-68-10073) LONGITUDINAL WAVES IN A PLASMA HALF SPACE. Black, W. M. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Oct. 10, 1967. 74p. (NASA-CR-90045; SR-311). CFSTI.

The electric field in a plasma half space is determined using a normal mode analysis with collisions considered using a BGK particle conserving collision model. For the collisionless case, the results are shown to be equivalent to the results of Landau, who used transform methods. For distances greater than five Debye lengths from the boundary, and for collision frequencies up to $0.01\omega_\rho$, it is shown that collisions have little effect on the electric field except in the frequency range $0.95\omega_\rho < \omega < 1.2\omega_\rho$. Within this frequency band, collisions produce different kinds of effects, depending upon the frequency of the applied field and upon the collision frequency. For most of the frequencies, the field is damped more rapidly with distance. For special frequencies, however, collisions destroy the collisionless damping and reduce the total damping. (auth) (STAR)

34646 (N-68-10502) EFFECTS OF AXIAL GRADIENTS OF VELOCITY AND MAGNETIC FIELD, ELECTRODE STAGGER, AND ION SLIP ON PARAMETERS IN MHD ACCELERATORS. Hohl, Frank (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Nov. 1967. 40p. (NASA-TN-D-4239). CFSTI.

The distributions of current and potential have been determined for two linear Faraday plasma accelerators. The equations describing the electrical parameters of accelerators were reduced to two dimensions and numerical analysis was used to solve the equations. The internal resistance of the accelerator, the Hall potential gradient, and various other parameters have been calculated as functions of: velocity and magnetic field gradients along the channel axis, ion slip, various amounts of stagger of electrodes, the ratio of electrode width to insulator width, and the Hall parameter. The results are compared with previous theoretical work and with experimentally obtained data. (auth) (STAR)

34647 (N-68-11000) TEST-PARTICLE ANALYSIS OF PLASMA TURBULENCE IN ASTROPHYSICS. Hall, Donald Eugene (Stanford Univ., Calif. Inst. for Plasma Research). June 1967. 124p. (NASA-CR-90213; SU-IPR-192). CFSTI.

To investigate the origin of charged high-energy particles, an idealized problem was studied. Test particles are pictured in a general configuration of steady or slowly changing electromagnetic fields, to which an arbitrary spectrum of small random fluctuations is added to represent weak plasma turbulence. The behavior of particles is found in terms resembling the quasi-linear theory of plasma disturbances, and advantages of this method over the previously used Fokker–Planck approach are described. The limits of applicability of the theory are stated and explained. The particular case considered in detail is that of relativistic particles moving in stochastic fields in an otherwise uniformly magnetized plasma. Transverse cyclotron acceleration by low-frequency waves is proposed as the most significant process of stochastic acceleration. The relevant properties of quasars are reviewed and preliminary comparison is made between the model calculations and the observational data. It is concluded that stochastic acceleration is important in the generation of high-energy particles. (auth) (STAR)

34648 (NP-17503) CONVECTION OF WEAKLY IONIZED PLASMA IN A NONUNIFORM MAGNETIC FIELD. Simon, Albert (Rochester Univ., N. Y. Dept. of Mechanical and Aerospace Sciences). [1965]. 24p.

A weakly ionized plasma in a nonuniform magnetic field exhibits an instability analogous to the well-known flute instability of a fully ionized plasma. The instability sets in at a critical magnetic field. When this external field is slightly increased above the critical value, by the fractional amount Δ, only one mode goes unstable to begin with and it grows in amplitude to a finite limiting value. Using a general theory of the nonlinear behavior derived in an accompanying paper, the mode amplitude and frequency shift are evaluated as functions of Δ. The corresponding enhanced particle transport is evaluated. The results are first obtained in the quasi-linear approximation, but it is then shown that the mode-coupling contribution is negligible, and hence, that the result is generally valid for small Δ. (auth)

34649 (ORO-3405-21) PERIODIC PULLING AND THE TRANSITION TO TURBULENCE IN A SYSTEM WITH DISCRETE MODES. Technical Note BN 542. Lashinsky, Herbert (Maryland Univ., College Park). Apr. 1968. Contract AT(40-1)-3405. 43p. (CONF-680431-1). Dep. CFSTI.

From Symposium on Turbulence of Fluids and Plasmas, New York.

Experiments with thermal-plasma devices (Q machines) frequently reveal the existence of spontaneous steady-state plasma oscillations with wavelengths comparable with the system dimensions and with discrete, harmonically related, frequencies that correspond to the different azimuthal mode numbers of the universal drift instability in the cylindrical plasma column. The discrete-mode spectrum is observed at low oscillation amplitudes; at higher amplitudes the discrete-mode spectrum gives rise to a continuous noise spectrum, characteristic of turbulence, that implies the introduction of new degrees of freedom. A mechanism is described and analyzed by which this transition to turbulence can occur in a system characterized by a modest number of discrete modes. This mechanism, called "periodic pulling," provides a means for modulation of the amplitude and frequency of the discrete modes, thus generating sidebands that eventually broaden the discrete-mode frequencies until a continuous spectrum is produced. The analysis of periodic pulling is based on a model in which the modes are treated as an ensemble of van der Pol oscillators that are weakly coupled by the nonlinearity of the plasma medium. Periodic pulling then derives from the incomplete entrainment (locking) of a mode by a perturbation at a frequency close to the "free-running" mode frequency. (auth) (TSS)

34650 (TID-24491, pp 71-4) NONLINEAR COUPLING OF LOW-FREQUENCY OSCILLATIONS IN AN ELECTRON-CYCLOTRON RESONANCE DISCHARGE. Ingraham, J. C. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The experiments were carried out in helium gas at 0.02 torr pressure. The oscillations were detected by measuring the lf modulation of the microwave power reflected from the discharge, by capacitive pickup probes outside the discharge, and by electrical probes inside the discharge. Preliminary data are discussed. (M.O.W.)

34651 (TID-24491, pp 74-6) NONLINEAR COUPLING OF LOW-FREQUENCY IONIZATION WAVES. Swain, D. W. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A hot-cathode glow discharge is run in helium or argon in a discharge tube of 4-cm diameter. A sine wave from an oscillator fed to one of the grids will cause a wave to be launched in the plasma. Probes are used to detect the waves. No results have yet been obtained. (M.O.W.)

34652 (TID-24491, pp 76-85) REFRACTIVE ATTENUATION OF RADIATION IN A CYLINDRICAL PLASMA. Rogoff, G. L. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A calculation was made of the refractive attenuation in a cylindrically symmetric plasma column in which the refractive index is a function only of the radial distance from the axis of symmetry In particular, the refractive index corresponds to a parabolic electron density distribution with an adjustable radial density gradient. (M.O.W.)

34653 (TID-24491, pp 85-97) STOCHASTIC ACCELERATION IN BOUNDED PLASMAS. Manheimer, W. M. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Calculations were made for the particle acceleration mechanisms in a plasma. Theories for both the quasi-linear limit and the trapping limit are described. (M.O.W.)

34654 (TID-24491, pp 118-22) BEAM-PLASMA DISCHARGE: SYSTEM D. Bartsch, R. R. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The periodic field monotron model proposed for the experimental observations of a lf beam–plasma interaction with a low-level beam in the afterglow plasma of system D has been applied to the experimental results of Lieberman. The monotron treatment of Wesselberg has been adapted to the field pattern of the plasma cavity oscillations. The Landau damping of the plasma-cavity oscillations by the hot electrons has been determined for the parabolic mirror system of finite length by adapting the treatment of infinite system Landau damping which is due to Stix. (auth)

34655 (TID-24491, pp 123-6) OSCILLATIONS IN AN INHOMOGENEOUS COLD PLASMA. Bers, A.; Schneider, H. M. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The asymptotic response of an inhomogeneous cold plasma to an initial density or velocity perturbation is investigated. The complete time dependence of the voltage across a one-dimensional inhomogeneous plasma is derived, and it is evaluated for a specific density profile. (M.O.W.)

34656 (TID-24491, pp 127-30) COMPUTER SIMULATION OF AN INHOMOGENEOUS PLASMA. Schneider, H. M. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Computer simulation of an inhomogeneous cold plasma in which ions and electrons have the equilibrium density $N_0(x) = N_c/1 + x^2$ is described. (M.O.W.)

34657 (TID-24491, pp 131-6) FURTHER DISCUSSION ON ELECTRON BEAM SPACE-CHARGE WAVE INTERACTION WITH THE BACKWARD WAVE IN A COLD-PLASMA WAVEGUIDE. Chou, S. L.; Bers, A. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The backward-wave interaction is discussed with the aid of numerical solutions to the dispersion equation. (M.O.W.)

34658 (TID-24491, pp 137-40) GROWTH OF THE LOSSLESS ONE-DIMENSIONAL BEAM–PLASMA INTERACTION IN SPACE AND TIME. Davis, J. A. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The growth was found in space and time of v_b, the first-order beam velocity, in a system described by the dispersion relations $1 - \omega_p^2/\omega^2 - \omega_{pb}^2/(\omega - kv_0)^2 = 0$. (M.O.W.)

34659 (TID-24491, pp 177-82) EXPERIMENTAL STUDY OF ENHANCED CYCLOTRON RADIATION FROM AN ELECTRON-CYCLOTRON RESONANCE DISCHARGE. Speck, C. E. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Radiation characteristics of the instability, a detailed measurement of the magnetic field employed, and some basic characteristics of the discharge are discussed. All measurements were made with a background gas pressure of 2×10^{-5} torr hydrogen, a central field of 990 G, and a heating frequency of 2852 MHz. (M.O.W.)

34660 (TID-24491, pp 183-92) RESONANT AND NEAR-RESONANT WAVE–PARTICLE INTERACTIONS IN A TRANSVERSE PLASMA WAVE. Murakami, M.; Lidsky, L. M. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Some relationships with the quasi-linear theory for the transverse mode are discussed. Limitations of the straight-line orbit approximation are discussed. In order to cope with the instability of the straightforward orbit calculation to treat the turning points properly, a singular perturbation technique is introduced. The results are explained on a physical basis, and their relationship to Dupree's strong turbulence theory is pointed out. (M.O.W.)

34661 COMPUTER EXPERIMENTS ON SECOND-ORDER PERTURBATION IN A MAXWELLIAN PLASMA. Baumann, G. (Laboratoire de Physique des Milieux Ionises, Nancy, France); Braun, J. C.; Feix, M. R.; Crownfield, F. R. Jr. Phys. Lett., 27A: 88-9(June 3, 1968).

Computer experiments were used to check an analytic second-order theory of oscillations in a Maxwellian plasma. For this computer experiments, a Fourier–Hermite expansion of the distribution function in the phase space was used. The agreement is very good. (auth)

34662 PROPAGATION OF DENSITY PERTURBATIONS IN A PLASMA. Yamashita, Y.; Ikezi, H.; Sato, N.; Takahashi, N. (Nagoya Univ., Japan). Phys. Lett., 27A: 79-80(June 3, 1968).

The ion acoustic wave and a fast propagating signal are observed in a cesium plasma. The latter is considered to be a burst of accelerated plasma due to grid excitation. (auth)

34663 RELATIVE MACROSCOPIC EQUILIBRIUM OF A PLASMA WITH CYLINDRICAL SYMMETRY. Patraulea, N. N.; Postelnicu, N. (Institutul de Mecanica Fluidelor, Bucharest). Stud. Cercet. Mec. Apl., 27: 3-15(1968). (In Rumanian).

Investigation was made of the macroscopic equilibrium of a system of ions of like sign within a rotating reference system with constant angular velocity relative to a Galilean reference system for the case of a cylindrical configuration. Load diffusion due to the effect of thermal excitation is taken into account. (IAA)

34664 KINETIC THEORY OF PLASMAS: THE COMPTON EFFECT IN ASTROPHYSICS IN THE CASE OF AN INTENSE RADIATION. Peyraud, Jean (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 539-41(Feb. 26, 1968). (In French).

The results established previously (Compt. rend, 264, series B, 1967, p. 931) were used to determine the evolution of an intense radiation during its crossing of an ionized atmosphere. A displacement toward the red was shown for the radiation, both from the viewpoint of the continuous background and from the viewpoint of the eventual lines which it can permit. (tr-auth)

34665 COMPATIBILITY REQUIREMENTS IN BBGKY EXPANSION. Liboff, Richard L.; Perona, Giovanni E. (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.), 8: 2001-12(Oct. 1967).

The BBGKY equations are written in nondimensionalized form leaving two parameters α and β explicit. The coefficient α is a measure of the "strength" of the potential of interaction, while β is a measure of the "range" of the interaction potential. The s-particle distribution function is expanded about vanishing correlation with ϵ entering as a parameter of smallness. Nine cases are considered, depending on the order of magnitude of α and β (viz., ϵ, 1, ϵ^{-1}). Lowest order terms, in each of the cases considered, give a kinetic equation, together with subsidiary conditions. In the "rigid sphere" limit, the Vlasov equation appears together with a second-order differential constraint. The Vlasov equation alone appears in the Rosenbluth–Rostoker limit. A critical survey is made of the compatibility problem which is inherent to expansions of the BBGKY sequence. For the most part, the problem reduces to the compatibility of "type-1" constraint equations. These constraint conditions cause any given order set of equations to be over determined. (auth)

34666 EVOLUTION OF THE PROBABILITY DISTRIBUTIONS AND OF THE CORRELATION FUNCTIONS IN A BOGOLYUBOV PLASMA. Kritz, Arnold H. (Aeronautical Research Associates of Princeton, Inc., N. J.); Radin, S.; Sandri, G. J. Math. Phys. (N. Y.), 9: 325-35(Feb. 1968).

A matrix formulation of nonequilibrium statistical mechanics was adopted earlier to dilute gases ($nr_0^3 \ll 1$) and to small momentum transfer interactions ($\phi_0/kT \ll 1$). It is now shown that the matrix formulation of the nonequilibrium equations can be extended to the Bogolyubov gas ($\phi_0/kT = 1/nr_0^3 \ll 1$). The asymptotic behavior is calculated for times long compared with the plasma frequency for: (i) the probability distribution functions, and (ii) the Mayer correlation functions. The collision integrals that determine the higher-order kinetic equations for the Bogolyubov gas are thereby constructed. The calculations performed directly with the nonlinearly coupled Mayer functions are shown to be equivalent to those performed with the linearly coupled probability distribution functions. In lowest order our theory coincides with a result obtained previously by Bogolyubov. (auth)

34667 THE ELECTRIC CONDUCTIVITY OF A PLASMA AT LOW FREQUENCIES. Dobbertin, Rolf (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 671-3(Mar. 11, 1968). (In French).

A first approximation, containing a Fokker–Planck relaxation term, is derived for the electric conductivity of a plasma at low frequencies. Successive approximations are derived from the first. (J.S.R.)

34668 LOW-FREQUENCY ELECTROSTATIC QUASI-LINEAR WAVES IN A PLASMA IN THE PRESENCE OF A MAGNETIC FIELD. Sudano, Pantuso Jose (Institut d'Astrophysique, Paris. Conselho Nacional de Pesquisas, Brazil). Compt. Rend., Ser. A and B, 266: 674-6(Mar. 11, 1968). (In French).

From the general expression of the electric permissivity tensor of a plasma in a magnetic field, the low-frequency quasi-electrostatic waves are studied. It is suggested that these waves can play a role in the acceleration process of charged particles, particularly of cosmic rays. (tr-auth)

34669 PULSED PLASMA DISCHARGE SIMULATOR. Temps, Alfred J. Jr. (Fairchild Hiller Corp., Farmingdale, N. Y.). Rev. Sci. Instrum., 39: 918-19(June 1968).

An electronic circuit simulates the voltage and current response of a capacitor discharge through a plasma. The circuit features dual ignitrons which are switched consecutively and is adaptable to a wide variety of discharge parameters. (auth)

34670 CALCULATION OF THE NON-LINEAR TERMS OF THE DIFFUSION AND CONDUCTIVITY TENSORS OF AN INHOMOGENEOUS LORENTZ PLASMA. Jancel, Raymond (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 668-70(Mar. 11, 1968). (In French).

A method is proposed for the calculation of the harmonics and anisotropies of the electron current of an inhomogeneous Lorentz plasma exposed to the action of a high-frequency electric field. (tr-auth)

34671 CALCULATION OF THE ELECTRON DISTRIBUTION FUNCTION OF A WEAKLY IONIZED PLASMA IN TIME-DEPENDENT ELECTRIC AND MAGNETIC FIELDS. Stiller, W. (Arbeitsstelle fuer Statistische Physik, Leipzig). Phys. Lett., 27A: 102-3(June 3, 1968).

The Boltzmann equation is used in calculation of the electron distribution function of weakly ionized plasmas subjected to homogeneous time-dependent electric and magnetic fields. (auth)

34672 FINITE-AMPLITUDE RESISTIVE DRIFT WAVES. Stix, Thomas H. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Rev. Lett., 20: 1422-5(June 17, 1968). (MATT-589).

A calculation of mode–mode coupling for resistive drift waves, based on the ion and electron fluid equations, shows a stable limit cycle with rather small harmonic distortion. The calculated density modulation, however, is significantly larger than observed in experiments. Cross-field transport in the direction of pumpout appears when ion–ion collisions are introduced. (auth)

34673 BREMSSTRAHLUNG OF SLIGHTLY IONIZED PLASMAS. Hettner, G. (Technische Hochschule, Munich). Z. Phys., 211: 483-90(1968). (In German).

It is shown, that the continuous spectrum (free–free radiation) of a plasma in a thermal equilibrium—if the degree of ionization is slight—is produced not only by the electron–ion impacts, but also to a considerable extent by the impacts of electrons with the neutral atoms. Under this assumption the radiation of a mercury arc plasma in the infrared is calculated. The results are in good agreement with absolute radiation measurements in a wide range of frequencies and pressures. (auth)

34674 METHOD FOR THE MEASUREMENT OF THE INSTANTANEOUS VELOCITY OF PLASMA IN AN INDUCTION MACHINE WITH ANNULAR CHANNEL. Fournier, Gerard (ONERA, Chatillon-sous-Bagneux, France). Compt. Rend., Ser. A and B, 266: 502-5(Feb. 26, 1968). (In French).

The simultaneous measurement of the electromagnetic field (E,B) and the current density (j) in an annular accelerator with progressive wave makes it possible to determine the local values of the conductivity of the plasma in a certain number of discrete moments corresponding to the cancellation of the magnetic induction. An empirical relation was deduced between the apparent magnetic field for the operations studied. The velocity is given by the ratio E/B when the current density is zero, but can also be obtained for other cases by the intermediary of this conductivity law. (tr-auth)

34675 BOUNDARY VALUE PROBLEMS OF PLASMA LINEAR ELECTRODYNAMICS. Dnestrovskii, Yu. N.; Kostomarov, D. P. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 180: 45-7(May 1, 1968). (In Russian).

An integro-differential equation system describing electromagnetic wave propagation in a semiconfined magnetoactive plasma is obtained, considering an external magnetic field H_0 arbitrarily oriented in relation to the boundary. It is shown that its solution (as in ordinary electrodynamics) is determined as a single value in the case of the initial vectors E and H, and the boundary values of tangential components for the vector E are assigned. A strict mathematical verification is given for the solution. (R.V.J.)

34676 MEASUREMENT OF THE SCATTERING CROSS SECTION OF SLOW ELECTRONS IN INERT GASES BY THE SVCH METHOD. Volkov, Yu. M.; Zinov'ev, O. A.; Malyuta, D. D. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 209-18(Mar.-Apr. 1968). (In Russian).

The results of the investigation of the diffusion transport cross section of the scattering of slow (0.18- to 0.22-eV) electrons on the atoms of inert gases, measured with different SVCH methods, used in conjunction with optical (T_e and n_e) and electrical methods ($\sigma = f(T_e, n_e)$), are reported. An analytical approximation is made of the energy dependence of the diffusion transport cross section of inert gases. It agrees well with the results of the measurement in the effective range of the change of electron energy. The use of the limited approximation makes it possible to calculate the electron transfer coefficients of the plasma of inert gases in a wide temperature range. (tr-auth)

34677 OPTIMUM FREQUENCY RANGE OF STATIONARY INDUCTION DISCHARGE. Rovinskii, R. E.; Sobolev, A. P. Teplofiz. Vys. Temp., 6: 219-23(Mar.-Apr. 1968). (In Russian).

An analysis was made of the frequency dependence of the basic parameters of high-frequency induction discharge at high pressure. On the basis of the analysis, the limits of the frequency range, optimum from the point of view of obtaining a given temperature in the discharge, were established. Conclusions are made on the independence of the optimum frequency range on the type of gas and the gas channel velocity through the inductor. (tr-auth)

34678 RADIATIVE ESCAPE OF ENERGY FROM A DENSE HYDROGEN PLASMA. Yakobi, Yu. A.; Ivaniya, S. P.; Komin, A. V. Opt. Spectrosc. (USSR) (Engl. Transl.), 24: 13-15(Jan. 1968).

Translated from Opt. Spektrosk., 24: 29-33(Jan. 1968).

The absolute intensities of the radiation from flat isothermal layers of a hydrogen plasma were calculated in the pressure interval 1 to 100 atm, energy temperature interval 0.6 to 20 eV, and thickness range 0.1 to 100 cm. The calculations were made with an electronic computer by numerically integrating the spectral intensities. All the radiation mechanisms (including the wings of all the lines and the tails of all the recombination bands) were taken into account at each wavelength. The results are illustrated by plots. A plot is also presented of the intensity of a flat layer 30 cm thick at a pressure 100 atm in the temperature interval 0.01 to 100 eV. The calculation error is ~20%. (auth)

34679 DETERMINATION OF THE EQUATION OF STATE OF A COMPLETELY IONIZED HYDROGENOUS PLASMA BY A MONTE CARLO METHOD. Roger, Claudine; Salmon, Jean; Canevet, Guy (CEA, Paris). Compt. Rend., Ser. A and B, 266: 831-3(Mar. 25, 1968). (In French).

The interaction energy of a completely ionized hydrogenous plasma is calculated by a Monte Carlo method. The equation of state is deduced. The comparison of the results with those obtained by another method makes it possible to estimate to 1% the precision attained for the total energy. (tr-auth)

34680 NONEQUILIBRIUM IONIZATION HEATED BY DC ELECTRIC FIELD OR METASTABLE NITROGEN MOLECULES. Nomaguchi, Tamotsu; Ito, Toshio (Mitsubishi Electric Corp., Tokyo). Mitsubishi Denki Lab. Rep., 42: 626-31(Apr. 1968). (In Japanese).

Theoretical and experimental analyses were made of nonequilibrium ionization heated by a dc electric field or metastable nitrogen molecules. Measurements were made in an argon-potassium plasma at temperatures of 1,500 ~ 2,000°K. Experimental conductivity agrees well with theoretical values calculated from a two-temperature model. Increase of electron density due to collisions among metastable nitrogens and potassium atoms was experimentally observed. Long-lined metastable nitrogens ($A^3\Sigma^+u$) were produced by an arc jet heater used to heat the larger portion of an argon gas flow, when nitrogen gas is mixed with argon before the heater; relaxation profiles of electron density enhanced by metastable nitrogen were theoretically analyzed. (NSA of Japan)

34681 THEORY OF VLASOV PLASMA OSCILLATIONS IN A MAGNETIC FIELD. Watanabe, Yoiti (Osaka Univ.). Kakuyugo-Kenkyu, 20: 312-36(Mar. 1968). (In Japanese).

The eigenvalue theory of Vlasov plasma oscillations, developed by Case and other authors, is applied to the case where the waves propagate obliquely to the direction of constant magnetic field, externally imposed on a spatially homogeneous plasma. The plasma may have a general equilibrium distribution with certain few weak conditions. Many elliptically polarized high harmonic waves superpose in a transverse electric wave. This superposition, being impossible to be avoided by the choice of the initial condition, makes an anharmonic plasma oscillation, because of different phase velocities of partial waves. The spectra of the phase velocity are partly similar to those of velocity of density waves, and are derived from the dispersion equation. The spectra are, however, masked by other terms, and disappear, when the direction of propagation becomes perpendicular to the direction of the external magnetic field; so also do the phenomena due to the spectrum like Landau dampings, microinstabilities, and so on. (NSA of Japan)

34682 STUDY ON AN ELECTROMAGNETICALLY DRIVEN T-SHAPED SHOCK TUBE AND ON THE SHOCK INTERACTION PROBLEM WITH ELECTROMAGNETIC FIELD. Uchida, Motokazu (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 49: No. 11, 7-11 (Nov. 1967). (In Japanese).

To clarify the behavior of an electromagnetically driven T-shaped shock tube, experiments were performed. As the result, it was found that the attenuation of the velocity of a shock wave was fairly large but the precursor effect was not so large as to change the density behind the wave, and the distance between the wave and the contact face was small but it could be separated with over 1-mm Hg internal tube pressure. Thus, it was shown that if only caution were taken to the attenuation of the flow and to the short duration of the flow, the tube could be used for the experiments in magnetohydrodynamics. Then, with the T-shaped shock tube a study was made on the interaction of the shock wave and the electromagnetic field. It was shown that in the case of MHD power generators, etc., the velocity of a shock wave was hardly changed, whereas in plasma propulsions it was changed considerably, the mode of change agreeing well with the calculation. (NSA of Japan)

34683 EXPERIMENTAL STUDY OF THERMAL CONDUCTIVITY COEFFICIENT OF CESIUM VAPOURS AND CESIUM PLASMA. Zarkova, L.; Stefanov, B. Izv. Inst. Elektron., Bulg. Akad. Nauk, 2: 33-42(1966). (In Russian).

Experimental data are obtained for the thermal conductivity coefficient of cesium vapors in a temperature range 1000 to 2400°K and a pressure range 1 to 5 torr, corresponding to a degree of ionization up to 2×10^{-2}. A hot-wire method in a cold outer cylinder is used. In the 1000 to 1600°K range the values of λ are independent of the pressure ("frozen" coefficient of heat conductivity λ_0, determined by a pure kinetic interaction of two cesium atoms). In the 1600 to 2400°K range, i.e., under plasma conditions, λ sharply increases and depends on the pressure. The surplus coefficient $\lambda_i = \lambda - \lambda_0$ is due to ionization. Theoretical calculation of λ_i as sum of the heat conductivity by diffusion of ionization energy and the electron heat conductivity provides a possibility of evaluating the cross section of Cs–Cs interaction. (Abstr. Bulg. Sci. Lit.).

34684 DYNAMIC NONLINEAR MAGNETO-IONIC WAVE PROPAGATION. Rydbeck, O. E. H. (Chalmers Univ. of Tech., Goteborg). Ark. Geofys., 5: 305-67(1968).

Studies are reported on the basic, dynamic nonlinearities of the lossless ionized medium and the possible dynamic interactions between high and low intensity radio waves in the medium. The effects were studied of the plasma wave upon other signals in the medium, its main features and general order of magnitude. It is shown that the nonlinear fields are expressed by two separate and normally unequal polarization ratios. These are generally different from those of the primary waves; one is associated with the longitudinal nonlinearities and the other with the transverse nonlinearities. (Sweden)

34685 KINETIC THEORY OF PLASMAS AND MATTER-RADIATION INTERACTION. II. ACTION OF RADIATION ON THE ELECTRON DISTRIBUTION FUNCTION DURING COMPTON SCATTERING. Peyraud, J. (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 29: 306-10(Apr. 1968). (In French).

The Compton interaction is described by a Boltzmann operator; this operator is modified by induced emission terms. This operator is expanded following the perturbation caused to the electron motion during a Compton collision, and the radiation evolution equations are deduced. The energy and momentum transfer between radiation and electrons is calculated. (auth)

34686 FLOW DECELERATION OF T-TUBE PLASMAS IN A TRANSVERSE MAGNETIC FIELD. **Takeyama, Haruo; Oda, Toshiatsu; Yokota, Toshiaki; Myojin, Takahisa (Hiroshima Univ.). J. Sci. Hiroshima Univ. Ser. A-II, 31: 63-8(Aug. 1967).**

Streak camera observation has revealed that the helium plasma flow produced in a T tube is decelerated with an application of the transverse magnetic field, and that the plasma flow cannot penetrate the field of enough strength (≥12 kG). The result is in disagreement with that of Atkinson, Holden, and Fowler [J. Appl. Phys., 30: 801 (1959)], who observed the reflection at the field boundary. Streak photographs with slits perpendicular to the tube axis show a diffusion phenomenon of the plasma across the field. (auth)

34687 SELF-TRAPPING OF WHITE LIGHT AND THE RED SHIFT BY NONLINEAR OPTICAL EFFECTS IN A STELLAR PLASMA. Shimoda, Koichi (Tokyo Univ.). J. Phys. Soc. Jap., 24: 1380-93(June 1968).

Possible effects of self-trapping and red shift of incoherent light in a plasma under astronomical conditions are investigated. Nonlinear polarization of a plasma is produced either by an intensity-dependent electron density or by a nonlinearity in the electron displacement. Possibilities of self-trapping by nonlinear electronic polarization and by thermal effect in a plasma are studied. Then the red shift due to nonlinear electronic polarization and that due to forward Rayleigh scattering by thermal fluctuations are considered. Finally a sizable red shift and self-trapping of light are shown to possibly occur in a stellar plasma of high density in a large scale when the light source is bright and it is rich in ultraviolet radiation. The above mechanism suggests a novel interpretation of quasi-stellar objects. The model requires neither the cosmological distance nor relativistic velocity of recession nor large gravitational potential. (auth)

34688 EXPERIMENTAL INVESTIGATION OF AN IONIZING WAVE IN CROSSED ELECTRIC AND MAGNETIC FIELDS. **Enninger, J. (Royal Inst. of Tech., Stockholm). pp 520-7 of Proc. Seventh Int. Conf. on Phenomena in Ionized Gases, Volume 1, Belgrade, 1966.**

An ionizing wave was studied in a coaxial plasma gun with an azimuthal bias magnetic field. Current limitation kept the plasma partially ionized. The ratio between burning voltage of the discharge and bias magnetic field was remarkably constant over a large range of pressure (0.01 to 100 torr) and current (5 to 5500 A). The corresponding value of E/B was in 4 different gases ~ equal to $(2\ eV_i/m_a)^{1/2}$, where V_i = ionization potential and m_a = at. mass. The results could be explained for high pressures by the requirements of a thermal ionization process, while for low pressures it was necessary to consider nonthermal effects caused by the relative motion between a plasma and a neutral gas. It was concluded that the dynamic properties of a discharge in crossed electric and magnetic fields are closely connected with the ionization process as long as the input of energy is so low that the gas is only partially ionized. (BBB)

34689 SURFACE WAVES IN WARM PLASMA-LOADED WAVEGUIDES. **Ohkubo, M. (Gunma Univ., Maebashi, Japan). Elec. Eng. Jap. (Engl. Transl.), 86: 30-5(Dec. 1966).**

The effect of the surrounding medium, either a conducting waveguide or a dielectric tubing, on the surface waves along the plasma column is investigated. In the region of $\omega < \omega_p$, the presence of a conducting cylinder greatly influences the surface-wave dispersion. This effect is greater for smaller values of b/a. When the plasma column is surrounded by a dielectric layer, the effect of the surrounding medium is greater if the dielectric constant of the medium is large. The surface wave can exist in the region $\omega > \omega_p$, if the thermal effect of electrons is taken into account. For this case, unlike the $\omega < \omega_p$ region, the dispersion relation is much more independent of the surrounding medium. If the thermal velocity of electrons is close to the phase velocity of the wave, there may be a possibility of amplification for $\omega \gg \omega_p$. (BBB)

34690 NOZZLE ELECTRODES FOR A PLASMA JET GENERATOR. **Saeki, S. (Yamaguchi Univ., Japan). Elec. Eng. Jap. (Engl. Transl.), 87: 12-20(Mar. 1967).**

Several characteristics of various nozzle electrodes are studied; the tapered-front multiport nozzle electrode is examined in detail. Gas flow condition in the plasma-jet generator is affected considerably by the tapered portions at nozzle inlet and outlet, the diameter of the convergent portion and its aspect ratio, and the ratio of the cross section of the convergent portion to that of the outlet. These factors also determine the heating effect caused by confining the arc, the heat input to the nozzle electrode, and the stability of the jet. The tapered-front nozzle shows less damage on the electrode than the flat-front nozzle. The values of a_e/a_t and the nozzle outlet number are 3.2 and 0.8, respectively. About 90% of the total heat loss occurs at the nozzle electrode. This nozzle loss can be reduced by increasing the cooling effect of the gas. In the multiport nozzle, a small amount of gas is needed for converging the arc column. The arc voltage is low and gas heating efficiency is small. The jet enthalpy can be increased by setting the gap length at 10 to 15 mm and using diatomic gas. The $Ar-N_2$ gas (N_2 above 30%), should be used for the multiport nozzle. A large cooling effect of the molecule gas will compensate the decrease of the gas-flow rate. Because of the shielding gas flowing around the arc column, a stable jet can be obtained. This jet is about 3 times larger than that produced by the single-port nozzle. (BBB)

34691 THE MAGNETO-IONIC THEORY FOR DRIFTING PLASMA: THE WHISTLER MODE. **Sidhu, D. P.; Unz, H. (Univ. of Kansas, Lawrence). Trans. Kans. Acad. Sci., 70: 432-50 (1967).**

The derivation of the refractive index equation for the whistler mode of propagation in the magnetoionic theory for drifting plasma is given. The magnetoionic theory deals with the propagation of electromagnetic waves passing through a gas of neutral molecules in which is embedded a statistically homogeneous mixture of free electrons and neutralizing heavy positive ions in the presence of imposed uniform magnetic field. The complex refractive index and the wave polarization for electromagnetic waves traveling in the homogeneous cold stationary magnetoplasma are given by the Appleton–Hartree equation. The refractive index equation and the wave polarization for the whistler mode of propagation in the magnetoionic theory for drifting plasma were derived, where the electromagnetic wave propagation, magnetostatic field, and drift velocity are all in the same longitudinal direction. The corresponding cubic algebraic refractive index equation was solved numerically for different plasma parameters on an IBM 7040 digital computer and 12 representative curves out of almost 100 calculated are illustrated. (BBB)

34692 BOUNDARY LAYER WITH AN EXTERNAL MAGNETIC FIELD IN A PLASMA. **Ghoshal, S. (Jadavpur Univ., Calcutta). Rev. Roum. Sci. Tech., Ser. Mecan. Appl., 12: 827-30(1967).**

A solution of the boundary layer equations in a plasma in the presence of a magnetic field perpendicular to the direction of the flow has been deduced on the assumption c_p = constant, T = T (n) and Prandtl's number = 1. A similar solution in the case of a one-dimensional compressible flow has been obtained on the assumption T = T (n), c_p = constant and Prandtl's number = ¾. Due to the perpendicular magnetic field, there will be a force per unit volume which is well established: $f = -(\sigma/c^2)H_z^2$. The equations governing the motion are defined, with boundary conditions at $y = 0$, $n = \nu = 0$, $T = T_w$; at $y \to \infty$, $n \to n_\infty$, $T \to T_\infty$, $\nu \to 0$. The motion equations are expanded on the assumptions given and it is found that a solution of the form T = T (n) is possible. Then $c_pT' + n = 0$ is a solution. This solution allows an evaluation of T which is identical with the energy of Busemann. (BBB)

34693 EXPERIMENTAL INVESTIGATION OF MICROWAVE EMISSION OF QUASI-STATIONARY PLASMA. Gorokhov, N. A. At. Energ. (USSR), 24: 168-72(Feb. 1968). (In Russian).

Electromagnetic emission from plasma of the Tokamak device was investigated, using specially developed apparatus and techniques. It was established that the plasma is a source of intense emission in the microwave region. The dependence of the emission on the parameters of the discharge was investigated. The intense signals occur only in those discharge phases where the plasma formation is microscopically stable. The correlation of the generated signal with the fast particle beam, accelerated in a quasi-stationary electrical field, was established. The spectrum of the observed emission was investigated. It is suggested that the generation mechanism is related to the excitation of auto-oscillations of the finite plasma system. (tr-auth)

34694 AMPLIFICATION OF SHORT-WAVE RADIATION IN A PLASMA OF MULTIPLY CHARGED IONS. **Gudzenko, L. I.; Shelepin, L. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 7: 190-2(Apr. 5, 1968).**

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 246-8(Apr. 5, 1968).

The use of a plasma as a medium for amplification in the vacuum ultraviolet or the soft x-ray band is discussed. The requirements of absolute level population inversion are much more stringent than in the visible region. Primary emphasis is given to the conditions arising when a plasma of two chemical elements is rapidly heated. The selective population of energy levels is related to the energetics of charge exchange processes. It is shown that recent calculations for hydrogen, hydrogenlike ions, helium and lithium indicate that conditions for appreciable inversion become much more favorable with increasing number of "relaxation channels". Numerical values are given for charge exchange probabilities for velocities 10^5 to 10^6 cm/sec. Estimates show that the gain per centimeter of photon path in the plasma is sufficient in principle to develop a generator in the soft x-ray band. (M.O.W.)

34695 KINETIC EQUATIONS. II. DERIVATION OF KINETIC EQUATIONS BY PARTIAL SUMMATION. **Bahr, U.; Quaas, P.; Voss, K. (Technische Univ., Dresden). Z. Naturforsch., 23a: 638-43(May 1968).**

Kinetic equations are derived for the one-particle distribution function. They are valid for the kinetic state of a many-particle system, i.e., equations of the kind $i\partial/\partial t\ n_{1,t} = Tn_{1,t}$. (M.O.W.)

34696 KINETIC EQUATIONS. III. DIFFICULTIES IN THE DERIVATION OF KINETIC EQUATIONS. **Bahr, U.; Quaas, P.; Voss, K. (Technische Univ., Dresden). Z. Naturforsch., 23a: 644-8(May 1968).**

Difficulties due to divergent terms of the perturbation expansion appear in the use of perturbation-theory calculations. A detailed discussion of these difficulties shows them to be due to the occurrence of secular terms. The perturbation expansion of the S operator was investigated. The method of partial summations is proposed to overcome these difficulties. (M.O.W.)

34697 KINETIC EQUATIONS. I. INFORMATION-THEORETICAL DERIVATION OF A GENERAL EQUATION OF MOTION FOR THE ONE-PARTICLE DISTRIBUTION FUNCTION. **Bahr, U.; Quaas, P.; Voss, K. (Technische Univ., Dresden). Z. Naturforsch., 23a: 633-7(May 1968).**

Time evolution of macroscopic observables is discussed. With the results of the functional formalisms of classical perturbation theory and generalized statistical functionals, the general equation of motion of the one particle distribution functions follows from the formal equation of motion. (M.O.W.)

34698 GENERALIZED TRANSPORT EQUATIONS FOR PARTIALLY AND FULLY IONIZED NONEQUILIBRIUM GASES. **Kelleher, Dermod. Albuquerque, N. Mex., Univ. of New Mexico, 1967. 130p.**

Thesis.

Transport equations are developed for the number densities, mean velocities, temperatures, stresses and heat fluxes of the constituents of an ionized gas by taking velocity moments of the Boltzmann equation. These equations are closed out by utilizing the Grad 13-moment approximation for each distribution function. This approximation provides a representation for the distribution function of each constituent which has as its first term a Maxwellian about the constituent mean velocity, and remaining terms which describe the deviation of the distribution function from this local constituent Maxwellian and which have as their coefficients the constituent traceless stress tensor and the constituent heat flux vector defined relative to the mean constituent velocity. These equations, coupled with Maxwell's equations to describe the electric and magnetic fields, constitute a closed set. This set of equations is anticipated to have validity for plasma systems of arbitrary degree of ionization, the constituents of which need not be close to thermodynamic equilibrium with each other. By limiting attention to systems with slowly varying flows, transport expressions, which reflect the influence of electric and magnetic fields, are extracted and exhibited. (Disser. Abstr.)

34699 AN INVESTIGATION OF NONEQUILIBRIUM IN AN RF PLASMA. **Scholz, Paul Drummond. Evanston, Ill., Northwestern Univ., 1967. 108p.**

Thesis.

The types of equilibrium and nonequilibrium in an inductively sustained rf argon plasma were investigated, using emission spectroscopy as the diagnostic tool. A review of the various spectroscopic techniques indicated that the spatially resolved absolute line and continuum intensities could be used to determine the electron temperature and electron number density in a plasma in which the free electrons were Maxwellian and the upper bound levels were populated with a Boltzmann distribution. A line relaxation technique for measuring the electron–heavy particle temperature difference was also examined. The experimental study was carried out using an rf plasma with a fixed oscillator frequency of 4.2 MHz and a fixed plate input power of 2.0 kw. The plasma was contained in a 25-mm-i.d. quartz tube which was water cooled. The average axial, argon flow velocity was 9.0 cm/sec and the plasma was operated at static pressure levels of 0.01, 0.1, 0.5, and 1.0 atm. The spectral lateral intensity profiles of seven atom lines and the continuum centered at three wavelengths were measured and inverted into radial intensity profiles at each pressure level. The results of the experimental study indicated that the center half of the plasma was in local thermodynamic equilibrium at 1.0 and 0.5 atm. Departure from thermodynamic equilibrium began at 0.1 atm and was quite apparent at 0.01 atm. The bound states $3p_6$ and above were found to be populated with a Boltzmann distribution at the electron temperature for all pressures. The electron temperatures at 0.01 atm were found qualitatively to exceed greatly the heavy particle temperature indicating a high degree of nonspecies thermal equilibrium. (Disser. Abstr.)

34700 PROBABILITY DISTRIBUTIONS OF THE ELECTRIC AND MAGNETIC MICROFIELD IN A RELATIVISTIC PLASMA. **Weise, K. (Technische Hochschule, Hanover). Z. Phys., 212: 458-66(1968). (In German).**

The probability distributions of the electric and magnetic microfield at a fixed space point in a relativistic, nondegenerate, homogeneous, and isotropic plasma in thermodynamic equilibrium are determined using the Markov method and neglecting the particle interaction. They are found to be Holtsmarkians like the electric nonrelativistic microfield distribution, but the characteristic field strengths are increasing functions of temperature which are calculated. (auth)

34701 SHEAR VISCOSITY FOR A DEBYE–HUECKEL PLASMA. **Quaas, P. (Technische Univ., Dresden). Z. Naturforsch., 23a: 757-60(May 1968).**

The Kubo formula for the shear viscosity of a Debye–Hückel plasma is evaluated by an extension of Ernst's method. In the main the result can be shown to be equivalent to the result derived by Braun from the Lenard–Balescu equation with the Chapman–Enskog method. Moreover, a correction of Braun's result can be given as caused by the particle interaction. (auth)

34702 NUMERICAL INVESTIGATION OF CHARACTERISTIC MAGNITUDES WITH PLASMA MODELS. **Wilke, Karlheinz (Technische Hochschule, Hanover). Z. Naturforsch., 23a: 760-70(May 1968). (In German).**

A fully 3-dimensional plasma consisting of up to 96 charged particles is simulated in a computer. The plasma is confined to a sphere (or cube) with specularly reflecting walls. The forces are computed, using a predictor corrector method with variable time steps. From initial configurations randomly chosen, the evolution of the plasma is followed numerically. Distribution functions and moments with respect to various phase variables are obtained as time averages: the distribution of velocity, kinetic and potential energy, of the electric microfield, the micropotential as measured at a neutral point of reference (usually the center of the system), the mean square electric field, the microfield correlation function, and the particle relaxation times. As the sphere used in the experiments has dimensions only slightly larger than the Debye sphere, collective phenomena and those due to major density fluctuations cannot be expected. Despite these limitations the mean electric field is found to be high by ~10% compared to the Holtsmark field. Comparisons to existing theories with respect to the variables already mentioned were carried out. (auth)

34703 EXPERIMENTAL INVESTIGATION OF MICROWAVE OSCILLATIONS INDUCED BY THE INTERACTION OF AN ELECTRON BEAM WITH PLASMA. **Levitskii, S. M.; Shashurin, I. P. (Kiev State Univ.). Ukr. Fiz. Zh., 13: 570-6(Apr. 1968). (In Russian).**

The spatial distribution of the oscillation intensity and the spectrum along an experimental lamp in which an electron beam interacts with the plasma produced by it was investigated. When the plasma frequency is higher than the cyclotron frequency for electrons ($\omega_P > \omega_H$), the spectrum of oscillations has two maxima. Dependence of the coefficient of spatial increase of oscillations upon the frequency and velocity of the beam, as well as the propagation of a monochromatic signal along the beam–plasma system, were also studied. It was concluded that the first maximum, situated below ω_H, originates from the electron-beam interaction with a direct plasma-waveguide wave. The second maximum arises at frequencies close to ω_P and is the consequence of polarizational interaction of the electron beam with plasma. A good qualitative agreement is observed between the theory and experimental data. (auth)

34704 DISPERSION AND STABILITY OF TE WAVE IN A COLLISIONLESS PLASMA SLAB. **Xu, Zheng-hue; Lu, Quan-kang. Chin. J. Phys. (Peking) (Engl. Transl.), 22: 640-3(Jan. 1968).**

Translated from Wu Li Hsueh Pao, 22: 844-8(July 1966).

The Vlasov equation, together with the usual set of Maxwell's equations, is solved for simplified boundary conditions. (M.O.W.)

34705 NEGATIVE POINT-TO-PLANE BREAKDOWN IN A FREE-ELECTRON GAS. Hassoun, Abbass M. (Univ. of California, Berkeley). J. Appl. Phys., 39: 3236-43(June 1968).

The breakdown of a point-to-plane gap in pure He, under conditions where electrons do not attach to form negative ions with steady potential, has been observed using the two-photomultiplier technique for pressures from 50 to 220 torr. Using a dual-trace oscilloscope, oscillograms of luminosity and current, luminosity and potential, and potential and current as a function of time were made. Movement of luminosity across the gap with and without interference filters segregating direct electron-impact excitation from thermal ionization, together with still photographs of the arc, allowed a fairly complete diagnosis of the breakdown mechanism to be made. The breakdown initiates as a localized Townsend glow discharge that propagates axially as an initially restricted luminous potential-gradient front across the gap at from 4×10^6 cm/sec to 1×10^6 cm/sec. The cathode fall has a positive ion sheath of 4.5×10^{11} electrons/cm^3 maintaining ionization which spreads over the cathode surface, yielding an ion density in the restricted portion of the arc channel of the order of 10^{14} ions/cm^3. Ion plasma oscillations of 7 × 10 Hz occur during growth. These are associated with striations in the transient glow-discharge phase of growth, the arc phase being controlled by external circuitry. (auth)

34706 INTERFERENCE OF CHARACTERISTIC WAVES IN PLASMAS. Brand, G. F.; Hooker, C. A. (Univ. of Sydney). J. Appl. Phys., 39: 3118-21(June 1968).

The interference between the two characteristic waves in a magnetized plasma was studied for propagation both parallel and perpendicular to the magnetic field. A new microwave interferometer which has been used to measure electron densities is described. Besides having a simpler construction, it is more sensitive than existing interferometers in certain situations. (auth)

34707 PROBLEM IN THE THEORY OF PLASMAS. Arthurs, A. M.; Anderson, N. (Univ. of York, Eng.). Nuovo Cim., 55B: 566-9(June 11, 1968).

The problem of solving Poisson's equation $d^2\varphi/dx^2 = p(\varphi)$, where $p(\varphi) = (1 + r\varphi)^{-1/2} - e^{-\varphi}$, with boundary conditions $\varphi(0) = 0$ and $\varphi'(0) = X$, arises in the theory of plasmas, where φ is related to the electric potential. In the usual formulation of the problem there is no charge separation at $x = 0$, which implies $\varphi''(0) = 0$, and it is assumed that the electric field also vanishes there, i.e. $\varphi'(0) = 0$. In this case, the numerical solution of the nonlinear equations leads only to the trivial result $\varphi = 0$. To avoid this situation a gas is considered which is not neutral at $x = 0$ and takes the densities of ions and electrons to be $n_+(0) = \alpha N$, $n_-(0) = \beta N$, with $\alpha \neq \beta$. The corresponding Poisson equation is $d^2\varphi/dx^2 = f(\varphi)$, with $f(\varphi) = \alpha(1 + r\varphi)^{-1/2} - \beta e^{-\varphi}$. The solution of this equation subject to the conditions $\varphi(0) = 0$, $\varphi(1) = 1$ by means of variational principles is discussed. (M.O.W.)

34708 PLASMA DIFFUSION INTO A SIDE ARM. Emeleus, K. G. (Queen's Univ., Belfast). Int. J. Electron., 23: 587-90 (Dec. 1967).

An approximate analysis of the diffusion of a steady positive column or similar discharge into a side tube, in which the plasma is supposed to terminate where the wall-sheath fills the side tube, and where some allowance is made for change in electron temperature and diffusion coefficient, shows that the length of transverse plasma may often be roughly proportional to, and of the order of the radius of the side tube, with a correcting factor depending on the logarithms of the radius, electron temperature and concentration at the junction of main and side tubes. (auth) (UK)

34709 EQUILIBRIUM RADIATION FROM ISOTHERMAL HYDROGEN–HELIUM PLASMAS. Nelson, H. F.; Goulard, R. (Purdue Univ., Lafayette, Ind.). J. Quant. Spectrosc. Radiative Transfer, 8: 1351-72(June 1968).

The composition and radiation of high temperature hydrogen–helium plasmas were calculated for thicknesses of 0.1 to 10.0 cm for shock velocities of 140,000 and 190,000 ft/sec and for ambient densities from 10^{-7} to 10^{-4} g/cm^3. Results were obtained from 50/50 volumetric mixtures as well as for the pure He and the pure H cases. These plasmas are plane parallel isothermal layers in local thermodynamic equilibrium; their calculated radiation includes both line and continuum processes. Thirty-four helium lines are considered with Stark broadening as the principal broadening mechanism. Lyman, Balmer, Paschen and Brackett transitions below the thirteenth level are considered for atomic hydrogen and singly ionized helium. Doppler, natural and Stark broadening are considered for all transitions below the seventh level, while the lines involving the seventh through the twelfth levels are assumed to be broadened by electron impact. The emission results indicate that the layers are optically thin at low ambient densities and become optically thick as the ambient density increases. The line radiation is usually more important than the continuum at low ambient densities. As the ambient density increases, the continuum radiation becomes the major portion of the emitted radiation, not only because of the expected line saturation, but also because the plasma microfields reduce the ionization potential and thus eliminate many of the upper levels from which line transitions would have taken place. The drop of ultraviolet emissivity at high temperature is shown, as well as the respective roles of hydrogen and helium in the energy exchanges of H_2–He mixtures. (auth) (UK)

34710 DIAMAGNETISM OF A PLASMA COLUMN. Forrest, J. R.; Franklin, R. N. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 305: 251-7(1968).

It has long been known that the positive column of a gas discharge is diamagnetic as a result of the motions of the electrons in a longitudinal magnetic field, but there has been considerable discrepancy between theory and experimental measurements made on low pressure discharges. Calculations are reported based on a theory in which the ion motion is treated in a fluid approximation for parameters relevant to new experimental measurements. This theory automatically takes into account the effect of the magnetic field on electron temperature and electron number density distribution. It is shown that with this model, and sufficient knowledge of the discharge conditions, good agreement can be obtained between theory and experiment for magnetic fields typically less than 300 G. (auth) (UK)

34711 HALL EFFECT IN IONIZED GASES. Croitoru, Z. Rev. Gen. Elec., 77: 266-8(Mar. 1968). (In French).

Generally speaking, one should consider the Hall effect in gases as an inevitable inconvenience whenever electric and magnetic fields coexist in media at moderate pressures (and therefore with high electron mobility). The inconvenience can be surmounted in practical applications; the solutions proposed are not always rigorous. A generalized Ohm's law is developed, and the conductivity tensor terms σ_1 and σ_2 are plotted as a function of the parameter $\beta = \mu B$. It is shown how these terms can be evaluated to yield the density and electron mobility in the gas, and a rough sketch of the application of the problem for the MHD generator with segmented electrodes is given. This case is compared with that in which the electrodes are continuous but J is not perpendicular to V. (BBB)

Production of Plasma

34712 (AD-661327) ENERGY CONVERSION PLASMA RESEARCH. Annual Report No. 1, February 1, 1966–August 31, 1967. Schneider, R. T.; Fagen, W. F.; Bloss, W. H.; Metz, S. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). Contract Nonr-580(19). 57p. CFSTI.

An experimental apparatus was built consisting of power supply and discharge tube, which is capable of generating a powerful gas discharge on a pulsed basis. Short-duration, high-voltage pulses are applied to external electrodes. The resulting strong electric field gradient causes the gas (hydrogen under low pressure) inside the tube to become ionized, thus forming a plasma. This type of plasma is characterized by a high degree of ionization, rather high electron temperature, and low ion temperature (nonequilibrium plasma) and is known as quasi-steady high-frequency discharge. The main part of the electric power input is converted into plasma radiation disregarding small losses due to ohmic heating. Observed x radiation as well as microwave oscillations and light emission are functions of the plasma characteristics such as electron temperature and density. (auth) (USGRDR)

34713 (CLM-R-80) PLASMA PRODUCTION IN A GAS JET BY MICROWAVE IONIZATION. Hugill, J. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Dec. 1967. 12p. Dep. CFSTI. UK 2s. 6d.

An experiment is described in which cold, neutral gas issuing from a nozzle is ionized by a 2400-MHz alternating electric field. In the steady state the electron temperature in argon is 3.4 eV, and ions are accelerated by electron pressure gradients near the nozzle. When the gas flow is pulsed, the degree of ionization can be up to 2.9% and this does not represent the limit of the technique. Application to the filling of a closed magnetic trap is discussed. (auth)

34714 NONVACUUM ELECTRON BEAM. Arata, Yoshiaki; Tomie, Michio. Technol. Sep. Osaka Univ., 17: 303-14(Oct. 1967).

It has been shown that a narrow laminar flow of a focused high-energy electron beam, achieved by a combined action of a magnetic pinch effect and an electrostatic pinch effect, is induced in the atmosphere, as a nonvacuum electron beam (NV-EB), forced to pass through a long narrow pipe having a high flow resistance. Behavior of the beam in various gases and at pressures (10^{-4} to 10^{3} mm Hg), especially the generation of a beam plasma and the scattering and range of the beam are reported here. Several applications of the NV-EB are also described. (auth)

34715 PLASMA HEATING BY AN ELECTRON BEAM. Saenko, V. A.; Zhdanov, V. A. Radiotekh. Elektron., 12: 554-7(Mar. 1968). (In Russian).

Studies were made of ion energy distribution in the case of plasma with a heated electron component and its isotropic distribution in space and its relation to the low-frequency plasma oscillation spectra. An electron beam of 1 to 3 keV, and current of 0.1 to 0.8 A, was injected through an 8-mm-diameter and 5-cm-long anode channel into a magnetic mirror 15 cm long with 28-cm-dia discharge chamber. The magnetic field in the chamber center was 0.2 to 1 kG. The maximum vacuum of the device was 5×10^{-7} mm Hg. Graphical results of probe measurements show two types of beam–plasma discharge. In the first case, at relatively high gas pressures ($p \simeq 10^{-4}$ mm Hg), a dense ($n \simeq 10^{12}$ cm^{-3}) low-temperature plasma with a small number of accelerated ions formed in the discharge chamber. In the second case, at lower pressures ($p \simeq 10^{-6}$ mm Hg), the probes recorded an increased number and maximum-energy ions, with simultaneous appearance of plasma x radiation and fast electrons. The ion energy spectra and directional anisotropy obtained are analyzed. (R.V.J.)

34716 LASER-PRODUCED PLASMAS FROM SOLID DEUTERIUM TARGETS. Colin, C.; Durand, Y.; Floux, F.; Guyot, D.; Lnager, P.; Veyrie, P. (CEA, Villeneuve-Saint-Georges, France). J. Appl. Phys., 39: 2991-3(June 1968).

A 2-GW laser interacts with a solid deuterium target. Framing and streak pictures give the evolution of the plasma for different cases of focusing. A tentative interpretation is suggested. (auth)

Stability of Plasma

34717 (AD–664924) INVESTIGATION OF PLASMA INSTABILITIES AND ADDITIONAL MHD INVESTIGATIONS. Final Report No. 1, January 1–December 31, 1967. Cap, Ferdinand; Herrnegger, Franz; Unteregger, Peter; Tinhofer, Gottfried; Falser, Helmut (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Dec. 31, 1967. Contract F61052-67-C-0014. 103p. (AFOSR–68-0236). CFSTI.

The main purpose of the research is to develop mathematical methods for the treatment of nonlinear plasma stability problems for finite and infinite electric conductivity and to apply them to problems concerning the energy balance in magnetogasdynamic generators and in a magnetic nozzle. Concerning the magnetic nozzle, investigations were made on the magnetic boundary layer which is characterized by negligible ordinary viscosity and weak but dominant magnetic viscosity. The coaxial Hall current accelerator was investigated, taking into account ion slip and variable electric conductivity. The stability of an incompressible nondissipative plasma flow with unstable density gradient was investigated, using Laplace transformation. A procedure based on the normal mode analysis was used to investigate the influence of electric resistivity on the stability behavior. Furthermore, the problem of plasma-wave reflection was investigated using the Vlasov–Poisson equation. (auth) (USGRDR)

34718 (AD–665421) OVERSTABLE MODES DUE TO RESISTIVITY GRADIENTS IN A CURRENT-CARRYING PLASMA COLUMN. Pridmore-Brown, David C.; McPherson, Donald A. (Aerospace Corp., El Segundo, Calif.). Nov. 1967. Contract F04695-67-C-0158. 15p. (TR–0158(9220-02)-1; SAMSO-TR–68-49). CFSTI.

A set of overstable modes is found for a low-beta current-carrying plasma having high gradients of resistivity. It is suggested that these modes provide an explanation for the large-amplitude, spontaneous oscillations that have been observed in a fully ionized, current-carrying plasma column. (auth) (USGRDR)

34719 (ORO–3405-18) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Quarterly Report No. 8, September 1–November 30, 1967. Lashinsky, Herbert (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). June 12, 1968. Contract AT(40-1)-3405. 18p. Dep. CFSTI.

The installation of the Q machine was completed and preliminary experiments and calibration made, some of which are described. With the machine in operation, it was found desirable to reorganize the research program, shifting the emphasis to the experimental work rather than machine development and installation. In this connection the program was provisionally divided into three major parts: (1) physics of plasma waves and instabilities, (2) physics and technology of Q machines, and (3) general experimental methods. A brief description of these topics and some early results are given. (auth)

34720 ION–CYCLOTRON INSTABILITY IN A PLASMOID. Pistunovich, V. I.; Ryutov, D. D. JETP Lett. (USSR) (Engl. Transl.), 7: 180-2(Apr. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 234-7(Apr. 5, 1968).

Plasmoids obtained in pulsed plasma injectors usually contain ions having a considerable thermal scatter both in the longitudinal and transverse directions, with $T_{||i} \sim T_{\perp i}$. It is shown that motion of such a plasmoid along a homogeneous magnetic field excites in the latter, under certain conditions, ion-cyclotron oscillations that lead to a "conversion" of the transverse thermal energy of the ions into energy of longitudinal translational motion. Such a "conversion" can cause an appreciable decrease of the energy of the transverse motion of the ions, compared with the energy immediately after the emission of the plasmoid from the injector. (auth)

34721 DISSIPATIVE–PARAMETRIC BUILDUP OF OSCILLATIONS WITH ANOMALOUS DISPERSION IN A PLASMA SITUATED IN A HIGH-FREQUENCY FIELD. Silin, V. P. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 7: 187-90(Apr. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 242-6(Apr. 5, 1968).

Instability occurring in relatively weak fields, when the velocity of the oscillations of the electron is small compared with its thermal velocity, is discussed. It is shown that such an instability can be investigated experimentally with relative ease, and can lead to new qualitatively important effects, wherein a relatively weak high-frequency electromagnetic field experiences anomalously large turbulent absorption. (M.O.W.)

34722 OBSERVATION OF RESISTIVE INSTABILITIES IN A TOROIDAL PLASMA. Stuart, K.; Levi, E. (Polytechnic Inst. of Brooklyn, N. Y.). J. Appl. Phys., 39: 3069-73(June 1968).

An experiment is described in which resistive instabilities have been observed. Diagnostics of a hydrogen toroidal plasma indicate that a current-carrying plasma sheet breaks up into separate filaments. Experimental data for three distinct filament configurations agree well with the theoretical predictions. (auth)

34723 EFFECT OF INDUCTIVE AND CAPACITIVE WALLS ON THE DIOCOTRON INSTABILITY. Fisher, Shalom; Neil, V. Kelvin; Briggs, Richard J. (Univ. of California, Livermore). Contract W-7405-eng-48. J. Appl. Phys., 39: 3171-7(June 1968). (UCRL–70627).

The influence of inductive and capacitive walls on the diocotron effect in a cylindrical charge layer of arbitrary thickness and infinite length is analyzed by means of a hydromagnetic model. The density in the layer is such that $\omega_p^2/\omega_c^2 \ll 1$ holds, where ω_p is the plasma frequency and ω_c the cyclotron frequency. A dispersion relation is derived which relates the oscillation frequency and wave number to the wall impedances and the geometric parameters of the system. Stability criteria are also derived. (auth)

34724 INSTABILITY OF A NEUTRAL SHEET. Dobrowolny, M. (EURATOM-CNEN, Frascati, Italy). Nuovo Cim., 55B: 427-42(June 11, 1968).

The stability of a neutral sheet configuration with respect to mirrorlike perturbations is analyzed in the linear regime. An analytical expression for the linear growth rate of the low-frequency electromagnetic modes is derived using a simplified model for the particle orbits. Considerations on the actual mechanism of the instability are also given. (auth)

34725 POSSIBILITY OF SUPPRESSION OF INHOMOGENEOUS PLASMA DRIFT INSTABILITY BY FEEDBACK. Arsenin, V. V.; Chuyanov, V. A. At. Energ. (USSR), 24: 327-30(Apr. 1968). (In Russian).

Oscillations are studied in a rarefield plasma cylinder immersed in a homogeneous magnetic field and surrounded by a surface (radius $r = b$) with a potential proportional to a disturbed potential on the plasma boundary (radius $r = a$): $f(b) = \delta f(a)$. Such boundary conditions can be achieved with a special radio-technical system. The waves with phase velocities less than that of electron Larmer drift are known to grow when $\delta = 0$ (metallic wall). Selecting the proper δ it is possible to increase the phase velocities of the large scale perturbations to meet the damping conditions. The possibility of stabilization is demonstrated for the sharp boundary density distribution. The influence of Im δ (i.e. phase shift into the radio technical system) on stability is discussed. (auth)

Thermonuclear Processes

34726 (AD-665416) NEUTRON AND X-RAY PRODUCTION IN A FOCUSED Z PINCH. Meskan, David A.; van Paassen, Hugo L. L.; Comisar, Gerald G. (Aerospace Corp., El Segundo, Calif.). Dec. 1967. Contract F04695-67-C-0158. 22p. (TR-0158(3220-50)-1; SAMSO-TR-68-50). CFSTI.

Diagnostic studies were made of the neutrons and x rays produced by a paraboloidal geometry Z-pinch device (700 mtorr D_2, 15 kJ). The neutron energy spectra at 0 and 180° relative to the electric field applied at the pinch axis were obtained by nuclear emulsion techniques; they resemble the spectra obtained for linear pinches. The energy anisotropy can be explained in terms of a 90- to 130-keV deuteron beam that strikes stationary deuterons. Ross filters reveal complex x-ray spectra from 7 to 88 keV, while absorber studies reveal x radiation up to 350 keV. The spectrum from 7.11 to 29.2 keV is insensitive to neutron yield and fits the function $\omega^{1.7}$ as does plasma bremsstrahlung from the electron energy distribution $E^{-2.2}$. The relationship between the power-law spectrum and current MHD turbulence theories is discussed. The presence of energetic x rays and fast deuterons is not consistent with the boiler model of neutron production recently proposed by the Fillipovs. (auth) (USGRDR)

34727 (LA-DC-9327) ON THE MECHANISM OF NEUTRON PRODUCTION FROM THE DENSE PLASMA FOCUS. Bottoms, P. J.; Carpenter, J. P.; Mather, J. W.; Ware, K. D.; Williams, A. H. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 15p. (CONF-680805-2). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

It is now established that the dense plasma focus (DPF), a self-constricted plasma current discharge (z-pinch), is an intense source of neutrons (10^{10}/burst). The lifetime of the plasma, measured in terms of neutron production, is ~80 to 150 nsec. The DPF device consists of a 20-kV, 360-μf capacitor bank, coaxial electrodes of 15-cm-outer and 10-cm-inner diameter operating with deuterium gas pressures of 5 to 10 torr. An electron plasma temperature and density of 5 to 8 keV and $\sim 2 \times 10^{19}/cm^3$, respectively, are typical values. The initial heating of the plasma ions is accomplished during the rapid 2-dimensional r, z compression; the fountain shape of the converging current sheath produces plasma streaming and precludes any real confinement. A study of the pulsed neutron energy spectrum by the time-of-flight technique made at angles of 0, $\pi/2$, and π radians shows that the average neutron energy is 2.77, 2.59, and 2.22 MeV, respectively. The center-of-mass velocity of the plasma source is 1.24×10^8 cm/sec. The center-of-mass motion may be explained in terms of a high-energy stream of ions striking a dense stationary plasma (target model) or by a thermal plasma which is moving along the axis (moving isotropic model). Use is made of the intense neutron production as a diagnostic tool to investigate the angular distribution of neutron production. A comparison of the experimental results with theory is inconsistent for the target model, but is consistent with the moving thermal plasma model. If one assumes that the entire hot plasma is moving at velocity v_{cm}, then a paradox exists. For example, the time duration of neutron production and the observed streaming velocity would give an apparent plasma length of some tens of centimeters; this is not observed. It is suggested that only the plasma in the early stages of compression may exhibit the observed streaming velocity, and neutron production during the pulse may not be characterized by the observed cm velocity. (auth)

Shielding

Refer also to abstracts 33822 and 33827.

34728 (AD-661091) AN EXPERIMENTAL EVALUATION OF ROOF REDUCTION FACTORS WITHIN A MULTI-STORY STRUCTURE. Final Report. Spring, R.; McDonnell, C. H. (Conesco, Watertown, Mass.). Apr. 1967. Contract DACA31-67-C-0018. 63p. (PSDC-TR-16(Suppl.1)). CFSTI.

Fallout contamination deposited on the roof of a structure is, in many cases, the source of the primary radiation component of the total dose obtained at any point within the structure. Experiments were performed in which the doses from a source of radiation present on a roof were measured in many locations within a multi-story building. This report presents the results of these experiments for roof and floor mass thicknesses of 48.6 and 97.2 psf. Comparisons of the experimentally measured gamma doses with those determined theoretically have been shown throughout this report. Agreement between experiment and theory has, in general, been found to be good. (auth) (USGRDR)

34729 (AD-661459) THE MOMENTS METHOD USED TO DETERMINE THE ENERGY ALBEDO OF GAMMA RAYS FROM ^{137}Cs IMPINGING ON ALUMINUM AND IRON BARRIERS. Smith, Charles V.; Scofield, Norman E. (Naval Radiological Defense Lab., San Francisco, Calif.). Sept. 6, 1967. 36p. (USNRDL-TR-67-120). CFSTI.

The moments method, as outlined by Spencer and Fano, was used to calculate the differential angular energy distributions of gamma ray fluxes backscattered from semi-infinite media. A plane normal source is simulated in the calculation. The data in this report are specifically for the angular energy distributions of .662 MeV gamma rays from Cs-137 backscattered from semi-infinite media of aluminum and iron. The angles of detection are 110, 120, 130, 140, 150, and 160 degrees. The data were presented in tabular form. A graphical comparison is also shown between results from an albedo experiment and the moments method. All of the moments method data were obtained from a computer program developed at NRDL using moments generated at the National Bureau of Standards. (auth) (USGRDR)

34730 (AD-663563) NEUTRON AND GAMMA-RAY STREAMING THROUGH A TWO-LEGGED, THICK-WALL STEEL DUCT. Technical Report, January-June 1967. Gardner, L. B. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 1968. 25p. (NCEL-TR-558). CFSTI.

The validity of simplified formulas for calculating the protection against streaming neutrons and gamma rays afforded by thick-wall steel ducts was determined. The results of neutron and gamma-ray dose calculations by albedo techniques and the results of gamma-ray dose measurements performed for a two-legged, thick-wall steel duct were summarized. Original data are presented for (1) the Monte Carlo calculation of neutron and gamma-ray streaming; (2) survey meter measurement of neutron dose; (3) the measurement of neutron energy spectra by foil activation techniques and subsequent calculation of dose; and (4) the measurement of prompt gamma rays by a liquid scintillation detector and by pulse shape discrimination. The dose normalized to the dose at 1 cm in free air is a common parameter, allowing the intercomparison of the different experimental and theoretical results. The work verifies the semiemperical formulas of Song and Chapman for the calculation of normalized dose rates resulting from neutrons and gamma rays streaming through thick-wall steel ducts. It is also shown that 05R/STATEST and OGRE-G computer codes are considerably more precise than the ADONIS code for the same use of computer time. Concrete ducts are seen to offer slightly more protection than thick-wall steel ducts. (auth) (USGRDR)

34731 (AD-665003) FAST-NEUTRON STREAMING THROUGH CONCRETE DUCTS. THEORETICAL CALCULATIONS USING THE ALBEDO CONCEPT COMPARED WITH EXPERIMENTAL RESULTS. Song, Yo Taik (Naval Civil Engineering Lab., Port Hueneme, Calif.). Feb. 1968. 348p. (NCEL-TR-565). CFSTI.

As a part of studies of shielding for personnel shelters, fast-neutron streaming through two-legged rectangular air ducts in concrete was investigated theoretically and experimentally. In the theoretical study of the problem, the albedo concept was employed, and numerical values of neutron dose in the second leg of ducts of various sizes were computed by IBM 1620 computer. Neutron sources employed were the $T(d,n)^4He$ reaction (14 MeV), $D(d,n)^3He$ reaction (2.5 MeV), and plutonium-beryllium. Three sizes of concrete ducts were used as models: (1) 3 × 3 ft with a first-leg length of 15 ft; (2) 2 × 3 ft with a 12-ft first leg; and (3) 2 × 2 ft with a 12-ft first leg. In experiments, counting rates of a spherical dosimeter were measured in both the first and second legs of the ducts described for the neutron sources named. Comparisons show very good agreement between theoretical and experimental results. (auth) (USGRDR)

34732 INVARIANT IMBEDDING EQUATIONS FOR THE DISSIPATION FUNCTIONS OF AN INHOMOGENEOUS FINITE SLAB WITH ANISOTROPIC SCATTERING. Bellman, R.; Kagiwada, H.; Kalaba, R.; Ueno, S. (RAND Corp., Santa Monica, Calif.). J. Math. Phys. (N. Y.), 8: 2137-42(Oct. 1967).

Two complete sets of differential-integral equations are derived for the dissipation functions of an inhomogeneous finite slab which scatters anisotropically. The first set is for the case of monodirectional illumination of the upper boundary, and the second is for the monodirectional illumination of the lower boundary. Conservation equations link the reflection, transmission, and dissipation functions. (auth)

34733 PASSAGE OF RADIATION THROUGH INHOMOGENEITIES IN SHIELDS. Broder, D. L.; Mironov, V. N.; Popkov, K. K. (Inst. of Physics and Power Engineering, Obninsk, USSR). Kernenergie, 11: 61-72(Mar. 1968). (In Russian).

Theoretical and experimental data are given on the neutron and γ-ray penetration through shielding containing various types of inhomogeneities. The various types of inhomogeneities are reviewed and methods for calculating complex geometric forms of inhomogeneities in the shielding are evaluated. Gamma rays and neutrons streaming through cylindrical ducts, γ-rays passing a plane slot, transmission of neutrons through ducts in water, attenuation of neutrons by air ducts in shields, and distribution of γ rays along a cylindrical channel passing through graphite and paraffin–iron mixtures are analyzed. (R.V.J.)

34734 MEASURING THE DOSE FIELD OF MIXED RADIATION BEHIND A STEEL SHIELD. Zel'chinskii, M. O.; Komochkov.; Sychev, B. S.; Cherevatenko, A. P. At. Energ. (USSR), 24: 194-5(Feb. 1968). (In Russian).

Dose measurements were carried out on a tissue-equivalent ionization chamber having an effective volume of 120 cm^3. Values of dose, quality factor and neutron fluxes of different neutron energy groups were measured at different points along an inclined axis behind a steel plug. The neutron threshold detectors consisted of a scintillating plastic to detect neutrons with an energy $E_n > 20$ MeV from the $^{12}C \rightarrow {}^{11}C$ reaction, a phosphorous detector which registered neutrons with E_n of 2 to 20 MeV from the $^{31}P \rightarrow {}^{31}Si$ reaction, and indium in a cadmiun wrapping which detected resonance neutrons (E = 1.44 MeV) from the $^{115}In \rightarrow {}^{116m}In$ reaction. The results showed that there was a constant relationship between the neutron fluxes of different energies and the dose rates. The value of the quality factor (average of 6.2) did not depend on the radius of deviation in the geometry of the experiment. The equivalent dose rate in an iron shield depends only slightly on the high-energy neutron spectrum. (TTT)

34735 ONE SCHEME OF MODELING PARTICLE TRAJECTORIES IN SYSTEMS OF COMPLEX GEOMETRY. Kuropatenko, E. S.; Ogibin, V. N. Zh. Vyssh. Mat. Mat. Fiz., 8: 211-6(Jan.-Feb. 1968). (In Russian).

In solving computer problems by the Monte Carlo method that deal with the passage of particles through matter, it is frequently necessary to model particle trajectories in systems with a complicated geometrical structure. Only the path length depends on the geometry. In any computer program a geometry block is written in order to calculate the distance of the particle from the boundary. It is difficult to create a universal program which can be used even with complex systems. A simple scheme for such a program is presented that is simple in realization and free of undesirable features. A number of surface parameters are introduced to define 5 types of surfaces. All the surfaces of the system are broken down into elements of surface which are numbered in order beginning with one. Regions of system are also numbered in arbitrary order beginning with one. The external space surrounding the system is assigned a number of zero. The program calculates the distance of the particle from a surface, and determines when a particle leaves the system. (TTT)

34736 BACK YIELD OF NEUTRONS FROM SHIELDING BOMBARDED WITH 660-MeV PROTONS. Kimel, L. R.; Komochkov, M. M.; Sidorin, V. P.; Sychev, B. S.; Cherevatenko, A. P. At. Energ. (USSR), 24: 395-7(Apr. 1968). (In Russian).

Measurements were made of the inverse yield of high-energy neutrons ($E > 20$ MeV) and fast (evaporating) neutrons ($E < 20$ MeV) from the concrete shielding ($\rho = 2.35$ g/cm^3) at normal incidence of 660-MeV protons. Computed data are given for the integral inverse neutron yield from concrete ($\rho = 2.35$ g/cm^3) and iron ($\rho = 7.8$ g/cm^3), considering cascade neutrons emitted from the nuclei at $\pi/2 < \theta < \pi$ angle in the range from 20 to 100 MeV with the shape $1/E^n$ and angular distribution $4(\theta) = 1/4\pi(b + c \cos \theta)$. The smallest value of inverse cascade neutron yield was $n = 2$ and the largest $n = 1$. (R.V.J.)

34737 INFLUENCE OF SPLITTING OF SHIELD ON BUILDUP FACTOR. Kazanskii, Yu. A.; Kukhtevich, V. I.; Shemetenko, B. P. At. Energ. (USSR), 24: 391-2(Apr. 1968). (In Russian).

Experimental studies were made on behavior of the buildup factor from a ^{137}Cs source for different distances δ between the aluminum 45-cm-dia slabs with mean free path lengths of 2.81 and 1.97 thicknesses, respectively. A scintillation pulse counter, located behind the second slab, with a 3-cm-dia and 2-cm-high stilbene crystal was used for measuring the magnitude, proportional dose rate, and the intensity of γ radiation. An attempt was also made to determine theoretically the functions B (δ, L, and R) for a simple case L = 170.5 cm with the assumption that the spallation does not affect the spectrum or angular distribution of scattered radiation incident on the second slab. The scattered radiation incident on the detector is described by a previously developed formula. Results of theoretical and experimental data are in good agreement. (R.V.J.)

Solid-State Physics

Refer also to abstracts 33446, 33695, 34805, 34807, 35289, 35317, 35322, 35402, and 35737.

34738 (AD–664048) APPARATUS FOR THE MEASUREMENT OF THE MOESSBAUER EFFECT IN THIN FILMS. Report for March 1, 1964–April 1, 1965. Haury, Gerard L.; Rutner, Emile (Air Force Materials Lab., Wright–Patterson AFB, Ohio). Nov. 1967. 29p. (AFML-TR–67-299). CFSTI.

The purpose of the work was to examine a specific technique for obtaining Moessbauer spectra so that properties such as nuclear magnetic moments, specific heat, local magnetic field and Debye temperature could be determined for various materials. An apparatus was constructed for the measurement of the absorption coefficient for 14-keV gamma rays by a thin film absorber containing iron-57. The coefficient is a function of the relative velocity between the thin film absorber and an emitter (Moessbauer effect). The velocity was produced by means of a linear mechanical drive; the gamma-ray transmission rate versus velocity was automatically recorded. The system was calibrated using a cobalt-57 source diffused into a pure iron disc which radiated to an absorber of pure iron. The absorber was 1.0-mil thick; the velocity of the absorber was varied from ±0.1 to ±10 mm/sec. Both emitter and absorber were at room temperature. A Moessbauer spectrum having the same characteristic as reported by others was obtained with the apparatus. (auth) (USGRDR)

34739 (AERE-R–5725) COMPUTER PROGRAM FOR THE CORRECTION OF MEASURED INTEGRATED BRAGG INTENSITIES FOR FIRST-ORDER THERMAL DIFFUSE SCATTERING. Rouse, K. D.; Cooper, M. J. (Atomic Energy Research Establishment, Harwell (England)). Apr. 1968. 39p. Dep. CFSTI. UK 5s.6d.

Expressions for the contribution of first-order thermal diffuse scattering (TDS) to the measured integrated Bragg intensities of cubic single crystals are derived by extending the formulation of Nilsson. The approximation of an infinite slit height is avoided and the treatment is extended to $\Theta - 2\Theta$ (detector coupled 2:1 to the crystal) as well as ω (crystal rotating, detector stationary) scans. A computer program for correcting x-ray or neutron Bragg intensities for the contribution of first-order TDS, written for the IBM 7030, is also described and an example input and output are given. A version of the program for use on the IBM 360/65 is also available. (auth) (UK)

34740 (AERE-R–5757) GALLIUM ARSENIDE. A Review. Frey, J. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 18p. Dep. CFSTI. UK 3s. 0d.

This review sets out the properties and applications of GaAs. Current ion implantation work is also discussed. (auth) (UK)

34741 (COO–1112-157) STUDIES OF THE ACOUSTOELECTRIC EFFECT, ULTRASONIC ATTENUATION AND TRAPPING IN CADMIUM SULFIDE. Henrich, Victor Eugene (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 171p. Dep. CFSTI.

A study of ultrasonic attenuation and electron trapping in cadmium sulfide single crystals by means of the acoustoelectric effect is reported. CdS is strongly piezoelectric, giving rise to a large phonon–electron coupling. Conduction electrons can be generated by illumination resulting in acoustoelectric signals of sufficient magnitude to be analyzed in great detail. The acoustoelectric current waveforms generated when a burst of 30-MHz ultrasound, short compared to the sample, travels through it are studied. In a uniform crystal, the current should be proportional only to the acoustic energy density in the crystal and hence should decay exponentially with time. The decay time is a measure of the total ultrasonic attenuation. This method was used to measure ultrasonic attenuation as a function of conductivity in five CdS samples. By varying the conductivity, it was possible to determine the electronic and lattice parts of the attenuation separately. The method is independent of bond losses, transducer efficiencies, etc., and there is no limit to how large an attenuation can be measured (over 80 db/cm was measured). Currently available CdS crystals do not have a very homogeneous spatial distribution of impurities. The local conduction electron density reflects the impurity density there, and since our pulsed method watches a short sound burst pass through the sample, regions of different impurity density are observable in the acoustoelectric current. All but one of the crystals studied showed such spatial inhomogeneity, and it was necessary to formulate a model for the nonuniformity in order to explain the observed acoustoelectric waveforms. The model agreed fairly well with the data on most samples and gave excellent quantitative agreement for one crystal. The ultrasonic attenuation due to electrons was found to be accurately described by the theory of Hutson and White, and lattice attenuations of about 2 db/cm were measured. In addition to the attenuation measurements, the magnitude of the acoustoelectric current gives information about trapping parameters. On three samples there was no evidence for the presence of traps, but on one a strong effect was found. The data could be explained very well by the existence of a trap .39 eV below the conduction band with a density of 3.6×10^{15} cm^{-3}. These values are in agreement with those observed by other authors using different methods. (auth)

34742 (COO–1112-161) THE ROLE OF CROSS RELAXATION IN THE EXTRA ENDOR SPECTRUM OF VANADIUM IN TUTTON SALT CRYSTALS. Horner, Joseph LeFevre (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 128p. Dep. CFSTI.

Thesis.

An investigation was made of the ENDOR (electron nuclear double resonance) spectrum of the paramagnetic complex VO^{2+} imbedded in a diamagnetic host crystal of the Tutton salt $Zn(NH_4)_2(SO_4)_2$ $6H_2O$. In a normal ENDOR spectrum, either two or four lines are observed, depending on whether one of the two outermost EPR transitions or an inner EPR transition is induced. In the present case, up to fourteen ENDOR lines are observed. A calculation of the nuclear sublevels of the system, made from the rhombic spin Hamiltonian using perturbation theory through the second order, reveals that the extra ENDOR lines arise from transitions occurring among all fourteen nuclear sublevels. This breakdown of the normal ENDOR phenomenon can be understood in terms of interactions among neighboring vanadium atoms. The extra ENDOR lines were studied by measuring their transient response to the removal of the nuclear rf power, T_{REC}, as a function of temperature (4.2 and 2.34°K) and paramagnetic ion concentration (0.75 to 0.08% V : Zn by weight). The concentration is measured by a colorimetric analysis procedure. A model for the phenomena is proposed which consists of magnetic dipole–dipole interactions, and involves the cross relaxation theory proposed by Bloembergen, Shapiro, Pershan, and Artman. Calculations are made for a two-electron spin-flip process, assuming a linewidth for the process equal to the EPR linewidth. The recovery times are shown to be roughly 10^5 too large to account for the experimental results. The calculation is repeated for some four spin-flip processes using second-order time-dependent perturbation theory. The second-order (4-spin-interaction) models can only predict the correct time if the additional assumption of clustering by the vanadium ions in the host lattice is made. This model is inconsistent with the observed EPR line shape, linewidth, and hyperfine structure. The two electron spin flip process is re-examined for a dilute magnetic lattice where the structure in the wings of the line shape is sufficient to make the predicted cross relaxation time small compared to all other characteristic time constants of the system. Under this condition, the solution to the coupled differential rate equations predicts a recovery time, T_{REC}, nearly equal to the nuclear spin lattice relaxation time. This model then is compared to the experimental results with good agreement between theory and experiment. (auth)

34743 (ISS–67/34) LECTURES ON ELECTRON PARAMAGNETIC RESONANCE GIVEN AT THE ISTITUTO SUPERIORE DI SANITA, SEPTEMBER 9-15, 1967. Strandberg, M. W. P. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Oct. 6, 1967. 55p. Dep.

These lectures give the theoretical and experimental basis for understanding the phenomenon of electron paramagnetic resonance. After an introduction in which the systems of interest for EPR are specified along with the behavior of the susceptibility complex in the neighborhood of resonance, consideration is given to the problem of the Hamiltonian spin applied to the circuit approximation called crystal field theory. The third lecture deals with the problem of thermal equilibrium between the spin degree of freedom of the paramagnetic crystal and the lattice vibrations. The fourth lecture discusses the techniques which reveal the paramagnetic resonance signals and finally an allusion is made to other basic problems which can be attacked with these kinds of measurements. (auth)

34744 (JINR–P4-3794) SPIN–FONONNOE VZAIMODEISTVIE V FERROMAGNITNYKH KRISTALLAKH. (Spin–Phonon Interaction in Ferromagnetic Crystals). Tyablikov, S. V.; Konvent, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 26p. (In Russian). Dep.

It is shown that the spin–phonon interaction in the ferromagnetic crystals in the weak coupling approximation between phonon and spin subsystems leads to the renormalization of the phonon frequency due to the magnetization and to the renormalization of the energies of spin excitations due to the thermal motions of atoms. As a result, the velocity of sound is renormalized and the Curie point rises in the high-temperature region. The phonon subsystem was studied, taking into account some anharmonic effects, which may lead to the instability of the lattice. For calculation, the double-time temperature-dependent Green functions method is used. (tr-auth)

34745 (LA-DC–9228) LATTICE DYNAMICS OF GALLIUM PHOSPHIDE. Yarnell, John L.; Warren, John L.; Wenzel, Robert G. (Los Alamos Scientific Lab., N. Mex.); Dean, Paul J. (Bell Telephone Labs., Murray Hill, N. J.). [1968]. Contract W-7405-eng-36. 19p. (CONF-680501–4). Dep. CFSTI.

From Symposium on Inelastic Neutron Scattering, Copenhagen, Denmark.

Dispersion curves for phonons propagating in the [100], [110], and [111] directions in gallium phosphide have been measured using a three-axis neutron-diffraction spectrometer operating in the constant-Q mode. The sample was a pseudo single crystal which was prepared by gluing together 36 single-crystal plates of gallium phosphide 1 to 2.5 cm in diameter and ~0.07 cm thick. The plates were grown epitaxially on a substrate of gallium arsenide, and aligned individually by neutron diffraction. Rocking curves for eight reflections symmetrically distributed in the plane of the experiment had full widths at half maximum in the range 0.52 to 0.58° and were approximately Gaussian in shape. Gallium phosphide crystallizes in the zinc blende structure. A group theoretic analysis of the lattice dynamics of this structure and a shell model fit to the measured dispersion curves are presented. Various optical properties of gallium phosphide are discussed in terms of the phonon dispersion curves. In particular, the phonons which assist indirect electronic transitions are identified as those at the zone boundary in the [100] direction (symmetry point X) in agreement with theoretical and experimental indications that the extrema of the conduction and valence bands are at X and Γ (center of the zone), respectively. The LO branches lie above the TO branches in contradiction to the predictions of Keyes and Mitra. The shell model fit indicates that the charge on the gallium atom is negative. (auth)

34746 EVIDENCE OF A MOLECULAR ION $(OF)^{2-}$ IN MAGNESIA IRRADIATED BY NEUTRONS. Rius, G.; Cox, R. (CEN, Grenoble, France). Phys. Lett., 27A: 76-7(June 3, 1968). (In French).

Low-temperature neutron irradiation of MgO creates a paramagnetic defect with [111] symmetry. It is suggested that it is an $(OF)^{2-}$ molecular ion on an anion site. (auth)

34747 MOESSBAUER STUDY OF THE LOW-TEMPERATURE PHASES OF $CeSn_3$. Kanekar, C. R. (Tata Inst. of Fundamental Research, Bombay); Rao, K. R. P. Mallikarjuna; Rao, V. Udaya Shankar. Phys. Lett., 27A: 85-6(June 3, 1968).

The Mössbauer study of ^{119}Sn in $CeSn_3$ at 4.2°K has revealed the presence of two phases, one of which is ferromagnetic. These results are compared with earlier Knight-shift and susceptibility data in the paramagnetic state. (auth)

34748 THERMOLUMINESCENCE AND ASSOCIATED PHYSICAL PHENOMENA OF IRRADIATED IONIC CRYSTALS. Buckman, William Gordon. Chapel Hill, N. C., Univ. of North Carolina, 1967. 131p.

Thesis.

The thermoluminescence, color centers, and the dc electrical resistivity of Harshaw "pure" LiF, NaF, NaCl, KCl, and CaF_2 crystals were studied. The radiation sources consisted of ^{137}Cs, ^{60}Co, and an x-ray machine. A quadratic relation was found to exist between the F and M centers in LiF, NaF, and KCl. In general, the emission spectra differed in the different peaks of each glow curve. However, near room temperature the thermoluminescence spectra were very similar to the emission spectra observed during other modes of excitation (x rays, electrons, and deformation of previously irradiated crystals). No good correlation was found to exist between the area under the thermoluminescence glow curve and the disappearance of F centers, when the crystals were heated to successively higher temperatures. F-light photostimulation of the thermoluminescence peaks above room temperature was observed for KCl and NaCl. The LiF and NaF thermoluminescence was photostimulated by the illumination from a low-pressure mercury lamp. The ratio of the resistance after radiation exposure to the resistance before exposure was plotted versus temperature. A positive correlation was found between this ratio plot and the LiF thermoluminescence glow curve. Similarities were also found between the plot of these ratios and the thermoluminescence glow curves for KCl and NaCl. A tentative theory has been presented to explain the results and the correlations between the different physical phenomena. (TSS) (Diss. Abstr.)

34749 ON THE THEORY OF DYNAMIC POLARIZATION OF NUCLEI. Zviadadze, M. D. (Inst. of Physics of Semiconductors, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 49: 547-50 (Mar. 1968). (In Russian).

A theory of dynamic polarization and relaxation of nuclei was analyzed for the case of intermediate saturation (or when H_c is of the order of H_{local}) and considering the nonsecular terms of dipole–dipole interactions which appear during transition) into the coordinate system (xyz) with z axis directed along effective field. (R.V.J.)

34750 STIMULATION OF THERMOLUMINESCENCE IN IRRADIATED LITHIUM FLUORIDE. Tournon, J.; Dubois, M. (CEN, Saclay, Gif-sur-Yvette, France). Solid State Commun., 6: 247-9(May 1968). (In French).

Thermoluminescence in γ-irradiated LiF can be stimulated through the excitation of a certain center; the absorption band of this center is masked by the F band, but can be observed by a difference method. Stimulation through the F band itself was negligible under the experimental conditions. (auth) (UK)

34751 OBSERVATION OF ION BOMBARDMENT DAMAGE IN SILICON. Mazey, D. J.; Nelson, R. S.; Barnes, R. S. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Phil. Mag., 17: 1145-61(June 1968). (AERE-R-5623).

Thin films of single crystals of both n- and p-type silicon contain disordered zones ~50 Å in diameter, discernible in the electron microscope after bombardment with $\sim 10^{13}$ Ne^+ ions cm^{-2}. As the dose increases these zones become more numerous until eventually ($\gtrsim 10^{14}$ ions cm^{-2}) they overlap, creating a continuous surface layer that electron diffraction shows to be amorphous silicon. The individual zones disappear on annealing between 400 and 500°C, and at ~630°C the amorphous layer recrystallizes epitaxially upon the underlying silicon, leaving an array of dislocation loops and dipoles. The bombarded regions exhibit various hues until eventually, when they become completely amorphous, they appear "milky" due to the Rayleigh scattering of light. This appearance has been used as a convenient method to study the ion dose needed to form amorphous silicon as a function of the temperature of the silicon during bombardment. (auth)

34752 FISSION-FRAGMENT TRACKS IN SEMICONDUCTING LAYER STRUCTURES. Morgan, D. Vernon; Chadderton, L. T. (Cambridge Univ., Eng.). Phil. Mag., 17: 1135-43(June 1968).

Fission fragment irradiation of a number of semiconducting materials established that permanent tracks are formed only when the conductivity is $\lesssim 2 \times 10^3$ $(ohm\text{-}cm)^{-1}$. The intermittent nature of particle tracks is a characteristic of layer structures and further analysis confirmed that there is one defect per sandwich plane crossed by the fission particle. The intermittency is ascribed to the reduced energy loss of the fission fragment when it travels in the interplanar channel. (auth) (UK)

34753 ORIENTATION DEPENDENCE OF RUTHERFORD SCATTERING OF PROTONS FROM QUARTZ. Palmer, Derek W.; d'Artemare, E. (Ecole Normale Superieure, Paris). Phil. Mag., 17: 1195-1205(June 1968).

A minimum observed in the high-angle scattering yield for 415-keV protons incident on single-crystal quartz along directions close to that of the [0001] axis has an angular width indicating channelling of the protons by atomic rows. Comparison between the spectra of protons scattered from the quartz and from vitreous silica shows that the channelled protons could travel a mean distance of approximately 1.75 microns before being scattered into the random mode. (auth) (UK)

34754 PHOTOEFFECT IN IRRADIATED GERMANIUM CRYSTALS IN THE REGION OF DIRECT TRANSITIONS. Akimchenko, I. P.; Plotnikov, A. F. (Moscow Inst. of Physics). Fiz. Tekh. Poluprov., 2: 759-61(May 1968). (In Russian).

Absorption spectra and photoconductivity of Ge crystals irradiated at room temperature by 1-MeV electrons with flux of nearly 10^{17} el/cm^2 were investigated. Curves are shown for crystals alloyed with small amounts of lithium or oxygen. (R.V.J.)

34755 PERMEATION OF HYDROGEN THROUGH TUNGSTEN AND MOLYBDENUM. Frauenfelder, R. (Westinghouse Research Labs., Pittsburgh). J. Chem. Phys., 48: 3955-65(May 1, 1968).

Using ultrahigh-vacuum and mass-spectroscopic techniques, permeation of hydrogen through wrought- and vapor-deposited W tubes and through a drawn Mo tube has been measured for pressures between 10^{-6} and 200 torr and temperatures between 1050 and 2400°K. Permeation rates varied with pressure and temperature in a complex manner. Expressions for the permeation rate are derived on the assumptions that (a) the rate determining step of permeation is diffusion of hydrogen in the bulk of the sample, and (b) the rate of desorption of hydrogen atoms D_a, the rate of recombinative desorption of hydrogen molecules D_m, and the concentration of dissolved hydrogen atoms are each determined by the concentration of hydrogen atoms adsorbed on the metallic surface. For the hydrogen–tungsten system, this analysis agrees with measured rates over the entire range of temperature and pressure, and the experimental data is consistent with Hickmott's values for: the rates D_a and D_m; the sticking probability for hydrogen atoms; and the probability that an incident hydrogen molecule adsorbs as two atoms. For the hydrogen–molybdenum system, permeation is controlled by phase-boundary processes at low driving pressures. Measured permeation constants follow the equation $P = P_0 \exp(-Q_P/RT)$ above 1 torr. The results $P_0 = (1.5 \pm 0.5) \times 10^{-8}$ torr · liter $cm^{-1} \cdot sec^{-1} \cdot torr^{-½}$ and $Q_P = (31.5 \pm 1)$ kcal/mole are found for W. For Mo, the corresponding numbers are $(7.1 \pm 2) \times 10^{-4}$ and (21.5 ± 1). (auth)

34756 PERMEATION, DIFFUSION, AND SOLUTION OF NITROGEN IN TUNGSTEN AND MOLYBDENUM. Frauenfelder, R. (Westinghouse Research Labs., Pittsburgh). J. Chem. Phys., 48: 3966-71(May 1, 1968).

Using ultrahigh-vacuum and mass-spectroscopic techniques, permeation, diffusion, and solution of nitrogen in W and Mo have been measured for pressures between 5×10^{-5} and 500 torr and for temperatures between 1100 and 2500°K. Values for the permeation constants, P(torr · liter/cm · sec · torr), diffusion constants, D(cm^2/sec), and solubility constants, S(torr · liter/cm^3 · torr), are obtained. For nitrogen in Mo, the diffusion constant is in agreement with Zener's theory of interstitial atomic diffusion. For nitrogen in W, the frequency factor of the diffusion constant and the diffusion activation energy are abnormally high and not in agreement with Zener's theory. (auth)

34757 LOW-TEMPERATURE DEPARTURES FROM THE KORRINGA APPROXIMATION. Brewer, W. D.; Shirley, D. A.; Templeton, J. E. (Univ. of California, Berkeley). Phys. Lett., 27A: 81-2(June 3, 1968). (UCRL-18120).

Spin–lattice relaxation times for ^{60}Co in Fe were determined at temperatures of order 10^{-2} °K. Significant deviations from the Korringa law are observed at these temperatures. (auth)

34758 MOESSBAUER STUDIES OF ^{57}Fe IN ZEOLITES. Morice, J. A.; Rees, L. V. C. (Imperial Coll. of Science and Tech., London). Trans. Faraday Soc., 64: 1388-95(May 1968).

Moessbauer spectra of ^{57}Fe in various zeolites were obtained. When the iron was exchanged with the cations present in the zeolites as Fe^{3+}, simple two line spectra were found. When attempts were made to introduce Fe^{2+} into the lattices, complete breakdown of the structure occurred in all zeolites studied except clinoptilolite. The spectrum of Fe^{2+}-clinoptilotic, however, showed little evidence of Fe^{2+} in the structure, but consisted mainly of the two ferric lines. Valency changes occurred readily on dehydrating the various ferric zeolites; either a simple ferrous spectrum was derived, or more complicated spectra containing ionic ferric and ferrous states and lines due to covalent ferrous. The original ferric spectra were not reproduced on resorption of water. Filling the channels with water produced more simple ferrous spectra. On opening these samples to air, however, rapid oxidation occurred and the original simple ferric spectra were obtained. Calculations were made to ascertain the site of the ferric ion in Y-zeolite. Although these calculations involved many assumptions, best agreement was found for the S_{II} site in this zeolite. (auth) (UK)

34759 RADIATION RECOMBINATION IN $ZnSnP_2$ CRYSTALS. Berkovskii, F. M.; Garbuzov, D. Z.; Goryunova, N. A.; Loshakova, G. V.; Ryvkin, S. M.; Shpen'kov, G. P. Fiz. Tekh. Poluprov., 2: 744-7(May 1968). (In Russian).

Radiation recombination spectra and absolute magnitude of the quantum yield of $ZnSnP_2$ crystals were studied with specimens excited by a pulsed electron gun with energy up to 25 keV and current density of 10A/cm^2 at electron beam current up to 200 mA. The pulse duration varied from 0.1 to 1.0 μsec. The crystals of $ZnSnP_2$ synthesized at a slow rate of cooling had a chalcopyrite structure, and by rapid cooling a sphalerite structure. Measurements of long-wave radiation edge spectra at 80 and 300°K indicated the temperature expansion factor for the forbidden zone equal to $(\Delta E_g/\Delta T) = (1.5 \text{ to } 2) \times 10^{-4}$ eV/deg. Data obtained revealed a high probability of intrazonal radiation transitions in the $ZnSnP_2$ semiconductor. In the more ordered crystals with (chalcopyritic structure) the width of forbidden zone is 1.46 eV, and in the maximum disordered crystals it is 1.22 eV. (R.V.J.)

34760 THEORETICAL INVESTIGATION OF THE LATTICE SPECIFIC HEAT OF GADOLINIUM, DYSPROSIUM, AND ERBIUM

METALS. Sundstroem, Lorna J. (Technical Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 280, 1-52(1968).

A discussion of the basic lattice dynamics theory for hexagonal close-packed metals in the harmonic approximation is presented in which reference is made to the general tensor force model, central force model, and models containing a mixture of these. For the case of the heavy rare earth metals, recourse is made to an axially symmetric (A–S) model including up to third-nearest neighbors (n.n.). More neighbors cannot be included at this stage as the only available data are for the elastic constants of single crystals of gadolinium, dyprosium, and erbium. The last two are at room temperature only, whereas for Gd the temperature variation from 4°K upwards is available. The main advantage of the A–S model is that it requires only two force constants for each shell of neighbors. These interatomic force constants are expressed in the form of a bond-stretching or radial force, and a bond-bending or tangential force. The meanings of the parameters and force constants used in the A–S model are presented in fair detail along with the criterion developed for actual determination of the parameter that governs the relation between bond-bending force constants in the x and z directions. From solution of the dynamical equation, in which a suitable mesh of the irreducible $^1/_{24}$ of the Brillouin zone is chosen, frequency distribution functions are reported for Gd at 4, 150, and 298°K, and for Dy and Er at room temperature. The phonon dispersion curves in symmetry directions of the Brillouin zone are also given, as they give a good indication of how future theoretical and experimental work should be oriented. In particular the validity of the 3rd n.n. approximation could be immediately checked from these dispersion curves when compared with future experimental results. From the distribution functions, using a smoothing technique for the original histogram obtained from the computer, the lattice specific heats are calculated. A trend of decreasing lattice specific heat with increasing atomic weight is confirmed, and a system for extrapolating specific heat values for the other rare earths at finite temperatures is suggested which takes the temperature variation of Gd as a guide. The Debye theta curves are also investigated and a comparison is made with nonmagnetic lutetium. It is concluded that the A–S model appears to give a realistic representation of the lattice vibrations of the heavy rare earth metals studied. (auth) (TSS)

34761 WORK FUNCTION OF ALLOYS OF RHENIUM WITH YTTRIUM-GROUP RARE EARTH AND GADOLINIUM METALS. Pozhkov, S. E.; Kultashev, O. K. Radiotekh. Elektron., 12: 570-1 (Mar. 1968). (In Russian).

Work functions were determined according to the total emission current at zero field and specimen temperature using Richardson–Deshman equations at A = 120.4 A/cm^2 degree^2. The measurements were carried out in a vacuum of 10^{-8} mm Hg after heating the specimens from 1500 to 1800°K for several hours. Tabulated data for Re–Y, Re–Gd, Re–Tb, Re–Dy, Re–Ho, Re–Er, Re–Tm, and Re–Lu are given. (R.V.J.)

34762 YTTRIUM AND LANTHANUM SECONDARY ELECTRON EMISSION. Ermolaev, L. A.; Tsupko, Yu. K. Radiotekh. Elektron., 12: 571-3(Mar. 1968). (In Russian).

Experimental data are given on the secondary electron emission properties of yttrium and lanthanum measured on cooled targets (after being heated at elevated temperature) at residual gas pressure of 5×10^{-5} mm Hg. The thermal treatment of the specimens was carried out at temperatures exceeding their melting point (yttrium at 1700°K and lanthanum at 1600°K). The results showed that, for Y and La, energy spectra of slow secondary electrons are identical and their parameters are approximately the same, e.g., $\Delta E \sim 7.5$ eV and $E_m \sim 3.5$ eV, indicating the similarity of electron structure of these elements. (R.V.J.)

34763 EFFECT OF THE ORDER-DISORDER PHASE TRANSITION ON THE PROBABILITY OF THE MOESSBAUER EFFECT IN SOLID SOLUTIONS. Kvashnina, L. B.; Krivoglaz, M. A. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 25: 577-88(Apr. 1968). (In Russian).

By means of the quantum-statistical perturbation theory, the effect of regularity on the intensity of the Moessbauer lines for component atoms or for atom impurities in solid solutions was investigated. It is shown that the effects, related to the mass difference of the atoms, are not large, and the difference can lead to significant change in the intensity of the lines during establishment in the solution of order or disorder, to dissimilar values of the Debye–Waller factors for nodes of different type, and to their anisotropy (in some structures). The solutions for lattices of the β-brass type CuAu and Cu_3Au were studied in detail. (tr-auth)

34764 THE NATURE OF PARAMAGNETIC IMPERFECTIONS IN IRRADIATED LiF CRYSTALS. Vitol, A. Ya.; Shvarts, K. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 48-52(1968). (In Russian).

The EPR method was used to study isolated F centers, F-center clusters, and metallic lithium colloids in LiF irradiated in a reactor. Problems concerning EPR spectrum correlations with the assigned defects are discussed. (tr-auth)

34765 RADIOLUMINESCENCE OF ORGANIC MEDIA. II. EXPERIMENTAL VERIFICATION OF THE KINETIC STUDY. Voltz, R.; DuPont H.; Laustriat, G. (Centre de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 29: 297-305(Apr. 1968). (In French).

The equations derived earlier are compared with experimental data on the time dependence of intensity and on the integrated intensity of radioluminescence in organic single crystals and liquid solutions with or without dissolved molecular oxygen. In all cases, excellent agreement is found. It is shown that analysis of the results allows one to evaluate various parameters characterizing the spatial distribution and the evolution of molecules excited by fast charged particles. Such values are discussed and found to agree with completely independent estimates, confirming therefore the validity of the kinetic study presented in this work. (auth)

34766 PHOSPHORESCENCE DECAY OF CALCIUM OXIDE. Schwartz, Laurent-Marcel; Janin, Joseph (Univ., Lyon). J. Phys. (Paris), 29: 311-16(Apr. 1968). (In French).

A formula, verified within a large time interval by the phosphorescence decays of variously activated calcium oxide samples excited by uv light or γ rays, is set up by using a continuous exponential distribution of trap depths. (auth)

34767 STUDY OF THE MOBILITY AND DISTRIBUTION OF LOW-CONCENTRATION IMPURITIES IN METALS BY THE ISOTOPE INDICATION METHOD. Bartha, L.

Thesis.

For morphological studies on the conditions of distribution of radioactive impurities, high-resolution autoradiography combined with metallography were used. The model which was studied in the greatest detail was a system consisting of tin base material and silver impurity. It was found that at the individual grain boundaries depending on their orientation, different segregation concentrations are in equilibrium with a given silver concentration in the tin lattice. It follows that the solubility of a foreign substance in polycrystalline base material differs from the solubility of the same substance in the single crystal. A formula for the description of this changed value is given. An analogy was found between the orientation dependence of the segregation concentration and of the diffusion rate at the grain boundary. Equations are formulated for the description of the temperature dependence of the volume and grain boundary diffusion of silver in tin, namely:

$$D_v = 1.18 \times 10^{-4} \exp\left(-\frac{14{,}000}{RT}\right) \text{cm}^2 \text{ sec}$$

$$D_b = 3.9 \times 10^{-3} \exp\left(-\frac{6700}{RT}\right) \text{cm}^2 \text{ sec}$$

The width of the grain boundaries of tin was found to be 100 Å in the diffusion process, contrary to 5 Å as assumed by Fischer's grain-boundary diffusion theory. If the impurity concentration of silver is less than the solubility, then the impurity which is concentrated on the boundaries will migrate together with the migrating boundaries during the recrystallization of tin and at the end of the process will be found at the new boundaries. A method is described for the graphic analysis of the diffusion curve by means of which the numerical values of both D_v and D_b can be calculated from this curve. These findings contribute to the production of a desired impurity distribution, i.e., provide information on the distribution which may be anticipated after a given series of operations. (Hung. Tech. Abstr.)

34768 EXCITATION INTENSITY EFFECT OF RADIOLUMINESCENCE OF ALKALI-METAL-HALIDE PHOSPHORS. Aluker, E. D.; Chernov, S. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 53-61(1968). (In Russian).

CsI(Tl) emission centers from electron pulse excitation and at various current values and temperatures were measured. Possible quenchers at great values of excitation density are discussed. The evaluation of the quencher mechanisms and the experimental data analysis permit the conclusion that the basic mechanism of quenching, the activated radioluminescence at high excitation densities, is the competition of minor traps, for example, Tl^0 and V_k centers. (auth)

34769 ON QUANTUM EFFICIENCY OF F AND Tl^0 SCINTILLATIONS IN THALLIUM-ACTIVATED ALKALI METAL HALIDES. Plyavin, I. K.; Chernyak, V. G. (Inst. of Physics, Riga). Latv.

PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 7-12(1968). (In Russian).

The dependence of the relative quantum efficiency of F and Tl^0 scintillations on temperature was investigated. A comparison of this dependence in crystals x-irradiated at liquid nitrogen and room temperatures was made. The relative quantum efficiency was found to depend greatly on the concentration of hole-activator centers and of hole-color centers of the host crystal. (auth)

34770 CHEMICAL METHODS FOR INVESTIGATING RADIATION DEFECTS IN ALKALI METAL HALIDE CRYSTALS. Tiliks, Yu. E.; Shvarts, K. K.; Vikhareva, O. M. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 71-4 (1968). (In Russian).

A chemical method for investigating electronic color centers in irradiated and additively colored NaCl and KCl crystals has been developed. It has been shown that by dissolving the localized electronic state in crystals, a solvated electron is formed in the water solution. A series of chemical reactions for studying the electronic color centers in crystals have been suggested. (auth)

34771 SURFACE PROPERTIES OF SILICON AFTER IRRADIATION WITH IONS HAVING MODERATE ENERGIES. Pavlov, P. V.; Popov, Yu. S. (Lobachevskii State Univ., Gorki, Russia). Sov. Phys.-Solid State (Engl. Transl.), 9: 2431-4(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3082-6(Nov. 1967).

A study was made of the influence of the bombardment with nitrogen, boron, and helium ions of 50 keV energy on the frequency dependence of the intrinsic photoconductivity and the field-effect mobility of carriers in n- and p-type silicon. It was found that at room temperature the ambipolar nature of the conduction was disturbed by the irradiation of p-type Si with nitrogen and boron ions and of n-type Si with boron ions. It was concluded that radiation defects gave rise to recombination centers as well as energy centers at which the minority-carrier charge accumulated. (auth)

34772 ELECTRON-MICROSCOPE OBSERVATION OF DISLOCATION MOTION IN SILICON UNDER THE INFLUENCE OF AN ELECTRON BEAM. Myshlyaev, M. M.; Nikitenko, V. I.; Eremenko, V. G. (Inst. of Solid State Physics, Moscow). Sov. Phys.-Solid State (Engl. Transl.), 9: 2427-30(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3077-81(Nov. 1967).

Results are given of electron-microscope observations of dislocations arising in single crystals of silicon under the influence of concentrated loading in the temperature range from 200 to 700°C and during creep tests under conditions of uniaxial compression. It was discovered that in the presence of a high concentration of internal stress in the silicon film, dislocation motion occurred during the process of observation under the influence of an electron beam. It was also noted in samples tested in creep that very thin regions of the film did not contain dislocations. This is connected with a redistribution of dislocations in the process of thinning the film down to a thickness equal to twice the thickness of the surface layer, in which the dislocation mobility is significantly higher than in the bulk of the crystal. (auth)

34773 MECHANISM OF ELECTRON-STIMULATED DESORPTION OF OXYGEN FROM THE SURFACE OF TUNGSTEN. Zingerman, Ya. P.; Ishchuk, V. A. (Physics Inst., Kiev). Sov. Phys.-Solid State (Engl. Transl.), 9: 2638-40(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3347-50(Nov. 1967).

The electron-stimulated desorption (ESD) of oxygen from the (110), (100), and (111) faces of tungsten single crystals was investigated. Curves show the dependence of the ESD coefficient on electron energy. Results do not agree with earlier ideas of the ESD mechanism. A proposed mechanism that does agree with the results is based on the assumption that an electron desorption event is due to the inelastic interaction of primary electrons, not with the adsorbed oxygen atoms, but with those surface atoms of tungsten to which these adsorbed atoms are bound by covalent bonds. (A.G.W.)

34774 SPATIAL OSCILLATIONS OF SPIN DENSITY AND NUCLEAR MAGNETIC RESONANCE IN $RbCoF_3$. Petrov, M. P.; Nedlin, G. M. (Inst. for Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 9: 2556-63(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3246-56(Nov. 1967).

Nuclear magnetic resonance (NMR) is employed to measure the local magnetic fields at the ^{59}Co, ^{19}F, and ^{87}Rb nuclei in $RbCoF_3$ over a temperature range from 90 to 450°K. The spin density at the nuclei is calculated from the results. It is shown that in the paramagnetic phase (from NMR data, $T_N \approx 96°K$), the spin density oscillates in space and changes sign on going from F nuclei to Rb nuclei. A theoretical discussion is given of the nature of the spin density at Rb nuclei resulting from the interaction of the t_{2g} orbital of the cobalt 3d shell with the rubidium s orbitals. (auth)

34775 MOESSBAUER EFFECT AT ^{119}Sn NUCLEI IN SOME GARNET STRUCTURE COMPOUNDS. Lyubutin, I. S.; Mill', B. V. (Inst. of Crystallography, Moscow). Sov. Phys.-Solid State (Engl. Transl.), 9: 2479-81(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3145-8(Nov. 1967).

The Mössbauer effect at ^{119}Sn nuclei was studied in six garnet-structure compounds that contain the Sr^{4+} ion. In some of these garnets the Sn^{4+} ion occupies both octahedral and tetrahedral sites. It has been found that for the Sn^{4+} ions located at tetrahedral sites the isomer shift (relative to SnO_2) amounts to +0.86 mm/sec, while for ions in octahedral sites in garnets the isomer shift is close to zero. (auth)

34776 ANISOTROPY OF THE ORIENTATION OF THE TRACKS OF URANIUM FISSION FRAGMENTS IN LiF SINGLE CRYSTALS. Geguzin, Ya. E.; Berzina, I. G.; Vorob'eva, I. V. (Gorkii State Univ., Kharkov). Sov. Phys.-Solid State (Engl. Transl.), 9: 2642-3(May 1968).

Translated from Fiz. Tverd. Tela, 9: 3350-2(Nov. 1967).

A uranium film deposited on an Al plate was placed in contact with a cleaved surface of a LiF single crystal, and the assembly was irradiated in a reactor. The orientation of each track produced in the crystal by fission fragments formed during irradiation was determined. The angular dependence of the relative number of tracks was plotted. The observed anisotropy is attributed to channeling of charged particles by the lattice. (A.G.W.)

34777 STUDIES OF Ge AND Si TETRAIODIDE CRYSTALS BY MEANS OF THE MOESSBAUER EFFECT IN ^{129}I. Bukshpan, S. (Soreq Nuclear Research Center, Yavne, Israel). J. Chem. Phys., 48: 4242-6(May 1, 1968).

The Mössbauer effect of the 27.7-keV ^{129}I transition was studied in GeI_4 and SiI_4 crystals. From the temperature dependence of the recoilless fraction, the characteristic Mössbauer temperatures were derived. Using these temperatures and a simple model for the Mössbauer factor in a molecular crystal, the Debye temperatures of the crystals were calculated. From the intensities of the peaks in the spectra, the absolute recoilless fractions were calculated. The intensities of various transitions in the spectra show the existence of the Goldanski effect. From the quadrupole coupling and isomer shift measurements, the character of the Ge–I and Si–I bond is derived. (auth)

34778 THERMOLUMINESCENCE FROM LOW-TEMPERATURE X-IRRADIATION OF Zn_2SiO_4: Mn AND $CaSO_4$ ADDED TO ALUMINA OR SILICA. Prydz, Svein; Petersen, Christian (Univ. of Oslo). Phys. Norv., 2: 331-41(1967).

Experimental studies on thermoluminescence induced in chromatographic media by low-temperature x irradiation are reported. Observed glow curves and spectra are discussed, and analysed in terms of contributions from the various components of the media investigated. The studies have a bearing on the method of tritium assay by luminescence measurements. (auth) (Norway)

34779 MEASUREMENT PROBLEMS IN NEUTRON DIFFRACTION. Jumpertz, Eduard A. (Univ., Bonn). Messtechnik, 76: 1-9(Jan. 1968). (In German).

Neutron diffraction, depending on availability of nuclear reactors as sources of radiation, suffers from some measuring problems, the reason of which lies in the limited primary intensity. A number of recent papers concerned with reduction of measuring time and improvement of resolving power are discussed. The progress was or will be achieved mainly by new detectors, neutron guides, and time-of-flight diffractometry. This extends the range of application of neutron diffraction. (auth)

34780 MAGNETORESISTANCE OF YTTERBIUM. Datars, W. R.; Tanuma, S. (McMaster Univ., Hamilton, Can.). Phys. Lett., 27A: 182-3(June 17, 1968).

The magnetoresistance of Yb at 1.3°K and in magnetic fields up to 20 kOe is reported. The Fermi surface of Yb supports no open orbits and the single-OPW model of Yb is not adequate. It is suggested that the Fermi surface is closed and occupies a small volume. (auth)

34781 MOESSBAUER LINE STRUCTURE IN NON-MAGNETIC Cu–Fe AND Cu–Ni–Fe ALLOYS. Swartzendruber, L. J.; Bennett, L. H. (National Bureau of Standards, Washington, D. C.). Phys. Lett., 27A: 141-2(June 17, 1968).

The high-temperature ^{57}Fe Moessbauer effect "doublet" line structure in Cu-rich Cu–Fe and Cu–Ni–Fe alloys (and the related Au–Fe) is reinterpreted as being magnetic in origin, rather than arising from quadrupole interactions. (auth)

34782 DIRECTIONAL AND TEMPERATURE DEPENDENCE OF LIGHT PULSES FROM ANTHRACENE CRYSTALS EXCITED

BY α PARTICLES. Boensch, Gerhard (Univ., Goettingen, Ger.). Z. Phys., 212: 497-510(1968). (In German).

The shape of scintillation pulses of anthracene crystals excited by 7.5-MeV α particles and their dependence on temperature and particle impact direction were investigated. With decreasing temperature the scintillation light is found to be emitted faster. The peak for particle impact directions parallel to the (a,b) plane at T = 20°K proves to be mainly caused by the delayed component. It is further shown that this peak at T = 50°K reaches maximum height for integration times of about 365 nsec, if compared with the minimum scintillation light yield at neighboring angles. The peak can be explained, if the theoretical model of King and Voltz for the delayed component is expanded by taking into account an anisotropy of triplet–exciton diffusion. (auth)

34783 DENSITY OF STATES FOR TRANSITION METALS. II. ISOCHROMAT SPECTROSCOPY OF HCP III- AND IV-A METALS. Merz, H.; Ulmer, K. (Univ., Karlsruhe, Ger.). Z. Phys., 212: 435-48(1968). (In German).

X-ray bremsstrahlung isochromats of the hcp metals Sc, Ti, Y, Zr, Lu, Hf and of the fcc metals La, Ce have been measured with high resolution under comparable conditions. The isochromats show that the width of the conduction band (d-band) grows from the 3d to the 5d row of the periodic table; within each row a rigid-band-model seems to be valid. In the 5d row only Lu fits well into this general trend of the transition metals: an x-ray spectroscopic argument is given that Lu, but not La, should be placed below Sc and Y in the periodic table. Long-range, low-frequency spin fluctuations, which appear in Sc, Y, Lu, are not visible in the observed isochromat curves. (auth)

34784 EXCITATION OF CRYSTAL LATTICE VIBRATIONS BY ELECTRON BEAMS. Boersch, H.; Geiger, J.; Stickel, W. (Technische Univ., Berlin). Z. Phys., 212: 130-45(1968). (In German).

The interaction of electrons with lattice vibrations in thin films of LiF, NaF, MgO, and Al_2O_3 was studied by means of high-resolution electron energy spectroscopy. Just above the excitation energy of the transversal optical modes small bands in the energy loss spectrum are observed. According to the dielectric theory of an unbounded medium, only longitudinal optical modes should be excited. The observed energy loss spectrum may be explained by the excitation of surface lattice vibrations. A theoretical energy loss spectrum of LiF has been computed taking into account the surface effects. It is in excellent agreement with the experimental spectrum. Apart from electrons with energy loss, electrons with energy gain were observed also. The intensity distribution of the energy gain spectrum is equivalent to the energy loss spectrum. Energy loss and gain spectra of fast electrons by excitation of lattice vibration are corresponding to the Stokes and anti-Stokes lines of spectroscopy of light optics. (auth)

34785 ON THE NMR LINE SHAPE OF A SYSTEM OF TWO APPROXIMATELY EQUAL SPINS. Geschke, D. (Karl-Marx-Univ., Leipzig). Z. Phys., 212: 169-75(1968). (In German).

The NMR line-shape function for a system of two nonequivalent spins with $I = S = 1/2$, $\gamma_I \approx \gamma_S$, has been calculated by means of Redfield's theory of relaxation, including the V matrix as introduced by Pfeifer. If the chemical shift of different protons is in the order of the line width, the resonance line shows a deviation from two overlapping Lorentz lines. It is pointed out, however, that the additional terms can be neglected in most cases. The result is of importance for the separation of high-resolution NMR spectra of adsorbed molecules in the case of intramolecular proton–proton interaction. (auth)

34786 MOESSBAUER EFFECT FOLLOWING COULOMB EXCITATION IN THE EVEN–EVEN ISOTOPES OF YTTERBIUM. Eck, J. S. (Johns Hopkins Univ., Baltimore); Lee, Y. K.; Walker, J. C.; Stevens, R. R. Jr. Phys. Rev., 156: 246-50(Apr. 10, 1967). (NYO–2028-5).

Moessbauer levels in ^{172}Yb, ^{174}Yb, and ^{176}Yb have been observed following the population of the first excited states by Coulomb excitation. Oxide and metallic targets and absorbers were used to determine the quadrupole energy splittings and relative quadrupole moments for each isotope. Coulomb-excitation cross-section data were used to determine the electric-field gradient at the nucleus for Yb^{3+} in Yb_2O_3. (auth)

34787 SHIFT OF LOCAL MAGNETIC FIELDS IN NUCLEAR RESONANCE OF RARE GASES. Brinkmann, D. (Univ., Zurich). Helv. Phys. Acta, 41: 367-84(May 15, 1968). (In German).

Measurements of the NMR local magnetic field shift of ^{83}Kr, ^{129}Xe, and ^{131}Xe in all three phases are reviewed and compared with theories. (auth)

34788 EFFECT OF IRRADIATION BY FAST NEUTRONS ON THE INTENSITY OF THE 220 REFLECTION OF PLANE CRYSTALS OF SILICON. Barrere, Gilbert (Faculte des Sciences, Paris). Compt. Rend., Ser. A and B, 266: 952-5(Apr. 1, 1968). (In French).

The results reported are relative, on one hand, to the case of Laue symmetric reflection of the K_α radiation of Cu for which $\mu t = 23.5$ (case of abnormal absorption) and, on the other hand, to the Bragg case for K_α radiation of Cu and Mo for the 220 reflections of Si. The reflecting capacity decreases when the irradiation dose increases in the case of Laue reflection in transmission and reflection, but no variation was registered in the case of Bragg reflection. Analogous experiments were made for the 220 reflection of Ge crystals (K_α radiation of Cu for the Laue symmetric case with $\mu t = 11.3$, case of abnormal absorption, and K_α of Cu and Mo in the Bragg case); they have shown no variation of reflective power with irradiation. (tr-auth)

34789 X-RAY INDUCED CONDUCTIVITY CHANGES IN InSb. Kruetz, E. W.; Pagnia, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi, 27: K111-14(June 1, 1968).

P-type single crystals of InSb were x irradiated at 79°K. The increase in electric conductivity at a given irradiation time was measured on various specimens of different thickness but constant hole concentration. Effects of various surface treatments on the magnitude and sign of the conductivity changes were investigated. The results indicate that the changes in electric conductivity are not caused by a production of defects in the bulk but by a surface effect. The model of electron emission over the interface barrier into surface states deduced from the spectral response in the visible and uv region seems best to explain the x-ray induced changes. (A.G.W.)

34790 DEFECT CLUSTERS IN NEUTRON-IRRADIATED RHENIUM. Brimhall, J. L.; Mastel, B. (Pacific Northwest Lab., Richland, Wash.). Contract AT(45-1)-1830. Phys. Status Solidi, 27: K89-92(June 1, 1968).

Stereo-electron microscopy was used to study defects in 99.992% pure rhenium irradiated by neutrons to a fluence of 1.5×10^{19} n/cm^2 at 550°C. The defects were found to be 25 to 120 Å in diameter and had a density of 0.5 to 1.0×10^{16} cm^{-3}. It is concluded that the predominant defect above 40 Å in diameter is an interstitial dislocation loop with Burgers vector a $\langle 11\bar{2}0\rangle$. (A.G.W.)

34791 INTERSTITIAL SOLUTE TRAPPING IN IRRADIATED AND QUENCHED IRON. Wuttig, M.; Stanley, J. T.; Birnbaum, H. K. (Univ. of Illinois, Urbana. Oak Ridge National Lab., Tenn.). Contract AT(11-1)-1198. Phys. Status Solidi, 27: 701-12(June 1, 1968). (COO–1198-391).

The interaction of interstitial carbon and nitrogen solutes with defects produced by low-temperature neutron irradiation and by quenching was studied in high-purity and Ferrovac E iron. Magnetic disaccommodation techniques were applied to determine the interstitial solute content after irradiation and upon annealing. Doses of about 10^{17} neutrons/cm^2 caused the trapping of about 20 ppM (atomic) interstitial solutes at 65 (carbon) and 40°C (nitrogen). Trapping of carbon in a Ferrovac E iron alloy occurred during a fast quench from 880°C. After trapping, the interstitial solutes reappeared in solid solution at 300 (carbon, neutron irradiation), 200 (nitrogen, neutron irradiation), and 620°C (carbon, quenching). Various possibilities for the defect traps were considered and it was concluded that trapping of the interstitial solutes occurred at iron interstitial clusters after neutron irradiation and at vacancy-type defects after quenching. (auth)

34792 RARE-GAS DIFFUSION IN NEUTRON-IRRADIATED RUBIDIUM HALIDES. Felix, F. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Status Solidi, 27: 529-34(June 1, 1968).

The release of radioactive Kr from neutron-irradiated single crystals of Rb halides is measured at temperatures ranging from 150°C up to the melting point. The release behavior is similar to earlier results on the K halides. The activation energies for RbCl, RbBr, and RbI at higher temperatures are 0.56, 0.30, and 0.31 eV, respectively. It is assumed that Kr diffuses by an interstitial mechanism. At lower temperatures a stronger dependence is found, which is attributed to the interaction of the gas atoms with defects. The activation energies in this region are 2.04, 1.68, and 1.41 eV, respectively. RbF shows only a single activation energy of 1.38 eV. In RbI the simultaneous diffusion of Kr and Xe is investigated. (auth)

34793 ULTRASONIC ATTENUATION IN UNIRRADIATED AND NEUTRON IRRADIATED QUARTZ. Fitzgerald, T. M.; Silverman, B. D. (Electronics Research Center, Cambridge, Mass.). Phys. Status Solidi, 27: 473-8(June 1, 1968).

The ultrasonic attenuation of unirradiated and neutron-irradiated quartz is discussed in terms of recent theoretical formulations of the three-phonon scattering mechanism. It is shown that the temperature dependence of the attenuation in the unirradiated quartz crystal can be understood by invoking this scattering mechanism. It is also shown that upon neutron irradiation the observed changes in the attenuation can be qualitatively understood by assuming that neutron irradiation decreases the thermal phonon lifetimes in the crystal. (auth)

34794 PRODUCTION OF COLLOIDAL CALCIUM BY ELECTRON IRRADIATION OF CaF_2 CRYSTALS. McLaughlan, S. D.; Evans, H. W. (Royal Radar Establishment, Worcestershire, Eng.). Phys. Status Solidi, 27: 695-700(June 1, 1968).

After irradiation with 75-keV electrons the optical absorption spectra of differently doped CaF_2 crystals show an identical broadband peaking between 515 and 565 nm, which is attributed to colloidal particles of calcium. Further evidence for the existence of a colloid is given by an ESR investigation. After irradiation most samples exhibit a narrow isotropic resonance $g = 2.006 \pm 0.001$, which is thought to arise from conduction-electron spin resonance in the particles of colloidal calcium. (auth)

34795 EVIDENCE FOR FRENKEL DEFECT RECOMBINATION DURING THERMAL ANNEALING OF LOW-TEMPERATURE X-IRRADIATED KCl. Balzer, R.; Peisl, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi, 27: K165-7(June 1, 1968).

Combined measurements of lattice-parameter and length change after isochronal annealing of x-irradiated KCl were made. The results agree within error limits with results to be expected if annealing is solely due to Frenkel pair recombination. (A.G.W.)

34796 MOESSBAUER EXPERIMENTS WITH COULOMB-EXCITED ^{73}Ge AFTER COULOMB RECOIL IMPLANTATION. Zimmermann, B. H.; Jena, H.; Ischenko, G.; Kilian, H.; Seyboth, D. (Univ., Erlangen-Nuernberg, Ger.). Phys. Status Solidi, 27: 639-51(June 1, 1968).

The nuclear resonance absorption of the 67.03-keV de-excitation radiation of $^{73}Ge^*$, Coulomb-excited by 20- to 30-MeV ^{16}O ions, is studied. The recoiling $^{73}Ge^*$ nuclei are implanted into a chromium substrate. The electronic configurations Ge ($4s^1 p^3$) in Ge (cryst.), Ge (15% ($4s^2 p^0$), 85% ($4s^2 p^2$)) in Ge (II)Se, Ge (62% ($4s^0 p^0$), 38% ($4s^1 p^3$)) in GeO_2 (hex.) and GeO_2 (tetr.) and the ratio $\delta R/R = 1.12 \times 10^{-3}$ of the nuclear charge radius are compatible with the measured isomeric shifts. Line broadenings and recoil-free fractions f of the implantation target and the absorbers are determined. At 78°K $f_{GeO_2(tetr.)}$ is greater than $f_{GeO_2(hex.)}$ by a factor of six. (auth)

34797 STATES OF IRON IMPURITY IONS IN AgCl AND NaCl INVESTIGATED BY THE MOESSBAUER METHOD. Hennig, K.; Yung, Kim; Skorchev, B. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Status Solidi, 27: K161-4(June 1, 1968).

The effects of annealing in He containing H_2O on the Moessbauer spectra of NaCl and AgCl doped with 10^{-4} mole % $^{57}CoCl_2$ were observed. Models explaining the results are considered. It is concluded that associations of Fe^{3+} ions with oxygen ions and vacancies are less probable than associations of Fe with oxygen ions only. (A.G.W.)

34798 STUDY OF IRON IONS IN ^{57}Fe-DOPED AgCl USING THE MOESSBAUER EFFECT. Hennig, K. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Status Solidi, 27: K115-16(June 1, 1968).

Moessbauer measurements on AgCl samples containing ≤0.05 mole % Fe confirm the interpretation of spectrum (I) previously given by Hennig, Meisel, and Schnorr [Phys. Status Solidi, 15: 199 (1966)] and Lindley and Debrunner [Phys. Rev., 146: 199 (1966)]. The spectrum (I) is explained as divalent substitutionally placed iron associated with a cation vacancy. The disappearance of the quadrupole splitting at temperatures ≳250°K is interpreted as the result of rapid motion of the vacancy around the iron ion. (A.G.W.)

34799 INDIRECT NUCLEAR SPIN RELAXATION IN FERROMAGNETIC HEAVY RARE EARTH METALS. Sherrington, D. (Univ. of Manchester, Eng.). J. Phys., C, 1: 748-58(June 1968).

An investigation was made of the low-temperature relaxation of nuclear spins in ferromagnetic heavy rare earth metals by the Suhl–Nakamura mechanism of virtual magnon exchange. Numerical estimates of the rms homogeneous linewidth and Bloch decay time T_2 were made in ^{159}Tb, ^{161}Dy, and ^{163}Dy, using the 90°K Tb dispersion data of Møller and Houmann (1966). T_2 values of approximately $2\frac{1}{2}$, 25, and 12 μsec, respectively, were found. Sample inhomogeneous fields increased T_2 slightly, and these values were in reasonable agreement with the measurements of Kobayashi, Sano, and Itoh (1966 and 1967), who found values about twice as large. (auth) (UK)

34800 DARKENING OF SELECTED METAL OXIDES BY HYDROGEN ION IRRADIATION. Sienko, M. J.; Green, Georgia N.; Cucin, Robert L. (Cornell Univ., Ithaca, N. Y.). J. Geophys. Res., 73: 3972-3(June 15, 1968).

Haphe (1965) has shown that simulated solar-wind bombardment of rocks and rock powders changes their photometric properties in the direction of lunar surface characteristics. As part of a continuing program to investigate new defect structures derived from metal oxides, the darkened products resulting from hydrogen irradiation of the oxides of Sc, Al, and Si were examined. Results indicate that at least part of the darkening must be attributed to catalytic cracking of pump oil itself. (W.D.M.)

34801 MAGNETIC SUSCEPTIBILITY OF Pr^{4+} IN CeO_2. Engelhardt, L. M.; Figgis, B. N. (Univ. of Western Australia, Nedlands). J. Chem. Soc., A, No. 6, 1258-60(1968).

The magnetic susceptibility of the Pr^{4+} ion in dilute solid solution in CeO_2 was measured as a function of temperature between 85 and 300°K. The results are compared with the theory for the ^2F term of the f^1 configuration split by spin–orbit coupling and by the ligand field arising from the stereochemistry of a regular cube. They can be accounted for by this model, although the best fit set of parameters for the ligand field does not give a value for the sixth order spherical harmonic terms in good agreement with expectations from related systems where the co-ordination is from an octahedron of oxygen ligand atoms. (auth) (UK)

34802 VALIDITY OF NERNST–LINDEMANN EQUATION IN THE RANGE 24^0 TO 1800^0C IN TUNGSTEN. Sigh, R. P.; Verma, G. S. (Univ. of Allahabad, India). Solid State Commun., 6: 113-14(Feb. 1968).

Validity of the Nernst–Lindemann equation was investigated in tungsten in the temperature range 24 to 1800°C. It was shown that the equation underestimates the dilatational contribution to specific heat, and the temperature-independent parameter does not remain constant beyond 1300°C. (auth) (UK)

34803 STUDY OF THE MAGNETIC STRUCTURE OF THE COMPOUND TbAl BY NEUTRON DIFFRACTION. Becle, C.; Lemaire, R.; Parthe, E. (CEN, Grenoble, France). Solid State Commun., 6: 115-23(Feb. 1968). (In French).

The intermetallic compound TbAl crystallizes with the orthorhombic space group Pbcm (D_{2h}^{11}). The magnetic behavior shows an antiferromagnetic transition with a Néel temperature of 72°K. The unit magnetic cell is double the unit crystallographic cell and has a propagation vector [$\frac{1}{2}$ 0 0]. In the noncolinear magnetic structure the moments are almost tangential to the chains of atoms that lie along [0 1 0]. The structure is stabilized by strongly anisotropic exchange between the terbium ions, which is a result of the interactions with the conduction electrons. (auth) (UK)

34804 MAGNETIC PROPERTIES OF CeAs AND CeSb DEDUCED FROM NEUTRON-SCATTERING DATA. Rainford, B. (Oxford Univ.); Turberfield, K. C.; Busch, G.; Vogt, O. J. Phys., C, 1: 679-83(June 1968). (AERE-R-5638).

Neutron-inelastic-scattering and powder-diffraction techniques were used to study the crystal field splitting and magnetic ordering properties of CeAs and CeSb. Powder-diffraction data indicate a type-1 face-centred cubic magnetic ordering structure for CeAs with a moment of 0.68 $\mu_B \pm 10\%$ at 4.2°K. This value demonstrates that the ground state of Ce^{3+} in CeAs is a doublet. Inelastic-scattering measurements give directly a value of the crystal field splitting in this compound of 140 ± 10°K (12 MeV). The powder-diffraction data for CeSb could not be interpreted using any of the simple face-centred cubic types of antiferromagnetic ordering. The inelastic data show that the crystal field splitting is smaller than 25°K (2.1 MeV). (auth) (UK)

Theoretical Physics

Refer also to abstracts 34868 and 35095.

34805 (AD–662675) A TEST OF TIME REVERSAL INVARIANCE USING THE MOESSBAUER TRANSMISSION OF THE 73-keV TRANSITION IN ^{193}Ir. Atac, Muzaffer (Illinois Univ., Urbana. Dept. of Physics). Nov. 1967. Contract N00014-67-A-0305-0005). 97p. (TR–165). CFSTI.

Real and imaginary part of the E2–M1 mixing ratio of the 73 keV transition in ^{193}Ir were determined in an arrangement that requires no correction for Faraday rotation and isomer shift. The parameters, E-gamma = 73.8 keV, g 1/2 = 0.9408, R-delta = 0.556, H = 1.437 MG, and f = 0.5, were determined. The value Im-delta = (+1.0 plus or minus 1.7) × 0.001 results in a phase angle between E2 and M1 of eto = (+1.8 plus or minus 3.0) × 0.001, thus showing no evidence for a T violation. (auth) (USGRDR)

34806 (AD-665487) SOME CLASSICAL RELATIVISTIC ELECTRODYNAMIC RELATIONS DERIVED FROM SYSTEMS OF CHARGED PARTICLES. Libelo, Louis F. (Naval Ordnance Lab., White Oak, Md.). Dec. 28, 1967. 16p. (NOLTR-67-190). CFSTI.

A completely non-quantum mechanical derivation was made of the macroscopic polarization–magnetization tensor from a system of discrete-, randomly translating dipoles. Also derived from the same system is the well-known macroscopic equation relating the four-current density to the magnetization-polarization tensor. (auth) (USGRDR)

34807 (BNL-12468) MOLECULAR FIELD CALCULATION. Kitchens, T. A. (Brookhaven National Lab., Upton, N. Y.). May 6, 1968. 15p. Dep. CFSTI.

A Fortran IV program to compute the magnetization of a Molecular Field Ferromagnet in an applied field is presented. Example cases are tabulated and graphed. (auth)

34808 ORBITAL ANGULAR MOMENTUM AND GROUP REPRESENTATIONS. van Winter, Clasine (Rijksuniversiteit, Groningen, Netherlands). Ann. Phys. (N. Y.), 47: 232-74(1968).

A new approach is presented to the question why in quantum mechanics the orbital angular momentum has integral eigenvalues only. The problem is formulated in terms of linear operators on the Hilbert space H of square-integrable functions of the angular variables φ and cos ϑ. The components of the orbital angular momentum are represented by self-adjoint operators $L_j(j = x, y, z)$ on H which are constructed starting from the familiar differential operators in terms of ϑ and φ. The construction is possible in infinitely many ways. These are labeled by a continuous parameter δ, the choice $\delta = 0$ corresponding to integral eigenvalues. For every particular δ, the operator $\Sigma_j L_j^2$ has one and only one extension L^2 which is self-adjoint on H and such that, for each j, the domain of L^2 is contained in the domain of L_j. This L^2 is the only operator which may represent the square of the orbital angular momentum. It is only in the case $\delta = 0$ that L^2 commutes with each L_j. Also, $\delta = 0$ is the only case in which the spectra of L_x, L_y, and L_z are the same. These are results which refer directly to the outcome of measurements. It is suggested that this explains why nonintegral eigenvalues for the orbital angular momentum are not found in nature. It is observed that orbital momenta with nonintegral eigenvalues do not fit in the framework of group theory. This is discussed from a general point of view. For a set of self-adjoint operators L_j on some Hilbert space R to generate a unitary representation of a simply connected, compact, semisimple Lie group, it is shown to be necessary and sufficient that the operators L_j satisfy suitable commutation relations and commute with a self-adjoint Casimir operator L^2. If, in addition, the group is of rank 1, it is necessary that the generators all have the same spectrum, which must be symmetric with respect to the origin. There is thus a general connection between the occurrence of group representations and the properties of observables. (auth)

34809 INVARIANTS OF NEARLY PERIODIC HAMILTONIAN SYSTEMS. McNamara, B.; Whiteman, K. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Math. Phys. (N. Y.), 8: 2029-38(Oct. 1967).

A new and simple method of finding an invariant J of a nearly periodic dynamical system is presented. The Hamiltonian is written as $H = p_1 + \epsilon\Omega(q_i p_i)$, where Ω is periodic in q_1 and $\epsilon \ll 1$. The first four terms of the invariant series are found explicitly in terms of Ω using Poisson bracket and averaging operators. This invariant is related to the adiabatic invariant and to various constants of motion discussed in celestial mechanics, such as Whittaker's adelphic integral. J is shown to be an asymptotic constant by using the rigorous methods of Kruskal to calculate the adiabatic invariant K; it is found that $K/\tau = H - \epsilon J$, where τ is the period in q_1. The adelphic integral has different functional forms depending on the presence of resonant denominators, but is shown to be always a function of H and J. The present method provides a single functional form which is applicable even when Ω is only almost periodic in q_1. It is also much simpler than the methods of adiabatic invariant theory. (auth)

34810 NEW METHOD FOR LINEARIZING MANY-BODY EQUATIONS OF MOTION IN STATISTICAL MECHANICS. Roth, Laura M. (General Electric Co., Schenectady, N. Y.). Phys. Rev. Lett., 20: 1431-4(June 17, 1968).

A new criterion is proposed for linearizing many-body equations of motion which is well defined and is related to a stationary principle. The method is applied to the problem of correlation in a narrow s band and the results differ considerably from Hubbard's treatment of this problem. (auth)

34811 l-AVERAGED EXCHANGE TERM IN THE HARTREE-FOCK EQUATIONS. Garrett, W. R. (Oak Ridge National Lab., Tenn.); Mullins, L. D. J. Chem. Phys., 48: 4140-3(May 1, 1968).

A possible improvement of Slater's simplification of the Hartree–Fock equations was suggested by Harman, Callaway, and Acton wherein an averaged exchange potential was defined for each set of states having common orbital angular momentum. In the present paper, such an averaging is performed on the Hartree–Fock equations, and the resulting equations are solved self-consistently. Comparisons are made between results obtained from the l-averaged exchange approximation, Slater's average, the free-electron exchange approximation, and the complete Hartree–Fock method. With very little increase in computational difficulty, the l-averaged exchange approximation yields results which are an improvement over Slater's average or the free-electron exchange approximation. (auth)

34812 UNOCCUPIED NATURAL ORBITALS OF TWO-ELECTRON WAVE FUNCTIONS. Nazaroff, George V. (Univ. of Wisconsin, Madison). J. Chem. Phys., 48: 4327-8(May 1, 1968).

For an N-configuration, self-consistent field, two-electron triplet or singlet wave functions $\psi_N(\vec{r}_1,\vec{r}_2)$ may be obtained. For these functions a set of unoccupied natural orbitals (NO's) which complements the occupied NO's are defined and discussed. (TSS)

34813 REMARKS ON CANONICAL QUANTIZATION. Hurt, N. E. (New York Univ., N. Y.). Nuovo Cim., 55A: 534-42 (June 1, 1968).

Differential geometric concepts in canonical quantization are discussed. Souriau's "espace fibre quantifiant" is shown under certain conditions to be realized in contact structure. Illustrative examples of contact structures are examined. (auth)

34814 ENERGY LEVELS OF ELECTRONS IN ELECTROMAGNETIC WAVES. Prakash, Hari (Univ. of Allahabad, India). Indian J. Pure Appl. Phys., 5: 614(Dec. 1967).

The existence of an infinite number of energy levels of electrons of given momentum in an electromagnetic wave is shown from the solution given by D. M. Volkov of the Klein–Gordon wave equation (Z. Phys., 94: 250(1935)). (auth)

34815 PROCEEDINGS OF THE FIFTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, UNIVERSITY OF CALIFORNIA, JUNE 21–JULY 18, 1965 AND DECEMBER 27, 1965–JANUARY 7, 1966. VOLUME III. PHYSICAL SCIENCES AND ENGINEERING. LeCam, Lucien M.; Neyman, Jerzy (eds.). Berkeley, Calif., University of California Press, 1967. 338p. $10.00. (CONF-650679–(Vol.3)).

The first two volumes of the Proceedings of the Fifth Berkeley Symposium provide the broadest available coverage of present-day research in probability theory and mathematical statistics. Volume III is devoted to research connected with physical sciences, including astronomy, stochastic models of gases and of magnetism, spectral analysis of special processes, control problems, and reliability theory. Separate abstracts were prepared for 5 of the 20 papers. (W.D.M.)

For abstracts of individual papers see: 34180–34184.

34816 QUANTUM MECHANICAL CORRELATION FUNCTIONS FOR THE ELECTROMAGNETIC FIELD AND QUASI-PROBABILITY DISTRIBUTION FUNCTIONS. Graham, R.; Haake, F.; Haken, H.; Weidlich, W. (Univ., Stuttgart). Z. Phys., 213: 21-32(1968).

We give new formulae permitting the calculation of time ordered but otherwise arbitrary correlation functions K of electromagnetic field operators in terms of a class of quantum mechanical quasi-probability distribution functions. This class contains among others the socalled Q and P functions as well as the Wigner function. (auth)

34817 MAGNETIC INTERACTIONS BETWEEN CHARGED PARTICLES. Breitenberger, Ernst (Ohio Univ., Athens). Amer. J. Phys., 36: 505-15(June 1968).

The Lorentz forces exerted by freely moving charges upon one another are not equal and opposite. Conservation of canonical momentum requires, however, that the generalized forces (with components $\delta L/\delta x_j$) be equal and opposite. Elementary arguments show that the magnetic interaction terms in the Lagrangian are identical with Darwin's, even in the absence of retardation; they arise from relative motion and can therefore not be peremptorily excluded from every nonrelativistic problem involving charged particles, e.g., in plasma physics. The formulation of, and separation of variables in, two-body problems with noncentral forces calls for some care because of the wobble motion of the center of mass. In hydrogenic atoms the effects of the magnetic interaction are extremely small; they are contained in the known relativistic correction to the reduced mass correction to the fine structure. (auth)

34818 ASYMPTOTIC BEHAVIOR OF THE PAIR DISTRIBUTION FUNCTION OF A CLASSICAL ELECTRON GAS. Mitchell, D. J.; Ninham, B. W. (Univ. of New South Wales, Kensington). Phys. Lett., 27A: 154-5(June 17, 1968).

The asymptotic behavior of the pair distribution function of a classical electron gas is determined and found to disagree with the conjectured form of Lie and Ichikawa. (auth)

34819 CLOSURE PROPERTY FOR MANY-PARTICLE WAVE FUNCTIONS. Fitts, D. D. (Univ. of Pennsylvania, Philadelphia). Nuovo Cim., 55B: 557-61(June 11, 1968).

The closure property is derived for a set of orthonormal eigenfunctions of a many-particle Hamiltonian operator. The closure relation for a set of many-particle wave functions is found, and an application of this closure property to the transformation of the canonical ensemble partial function is given. (J.F.P.)

34820 A STUDY OF THE THREE-BODY PROBLEM IN QUANTUM MECHANICS. Marable, James Holley. Knoxville, Tenn., Univ. of Tennessee, 1967. 141p.
Thesis.

The usual classification of the coordinates of N-body systems as translational, rotational, or internal was further refined. In particular, the internal coordinates were divided into two classes: (1) three-size coordinates and (2) 3N-9 angular coordinates which specify elements of an orthogonal matrix. By means of these latter coordinates, an analogy may be made to the motion of a three-dimensional rigid body in an N-1 dimensional space. The form and structure of the metric tensor corresponding to the above classification is calculated. The formalism leads to a natural system of coordinates which is developed explicitly for the three- and four-body systems. Harmonic functions for the three-body system are investigated using the coordinates developed. The number of multiplets associated with a given orbital angular momentum quantum number is calculated. Use of these harmonic functions as a basis for expanding the wave function reduces Schroedinger's equation to a set of coupled ordinary differential equations. This leads to a simple method of calculating the wave function for a three-body system. A FORTRAN program has been written which calculates the S-state wave function of the bound three-body system. In particular, the Coulomb potential has been used to show the method gives reasonable results for the ground state of the helium atom. (Disser. Abstr.)

34821 DEVELOPMENTS IN THE DENSITY OF THE DISTRIBUTION FUNCTIONS OF BOGOLYUBOV. Asdrubal, Flores L. (Univ. Veracruzana, Jalapa, Mex.); Roberto, Alexander, K.; Gualtiero, Camisassa S. Rev. Mex. Fis., 17: No. 1, 47-58(1968). (In Spanish).

In the scheme of the transport coefficients of a dense-gas theory it is shown that the explicit form of the normalization condition influences neither the BBGKY hierarchy nor the power-density expansion of the two-particle distribution function. (tr-auth)

34822 POSSIBLE GENERALIZED INSTABILITY CRITERION APPLIED TO THE ONE-DIMENSIONAL δ-FUNCTION INTERACTING FERMI GAS. Johansson, B. (FOA, Stockholm). Nuovo Cim., 55B: 305-14(June 11, 1968).

When arriving at the transition point from the normal state, one collective excitation above the ground state will get unstable, thereby signaling the onset of a new phase of the system. However, when studying the collective modes around the normal state even beyond the transition point it is found that a whole series of different collective modes (all of the same character) are unstable. From this set of modes the "most unstable one" is found which, it is then argued, could provide some information on the character of the new state. These ideas are applied to the case of a one-dimensional Fermi gas with repulsive δ-function interactions between the particles. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

34823 ULTRA-HIGH ENERGY INTERACTIONS. Gierula, Jerzy (Instytut Badan Jadrowych, Krakow). Postepy Fiz., 19: 167-78(1968). (In Polish).

The report of experimental work in ultra-high energy interactions done in this country in the two year period between the successive Conferences of Polish Physicists is presented. (auth)

Electromagnetic

34824 (AD-448108) BACKWARD ANOMALY IN PI MESON PHOTOPRODUCTION. Hearn, A. C.; Schaerf, C. (Stanford Univ., Calif. High-Energy Physics Lab.). July 1964. Contracts Nonr-225(67); AF49(638)-1389. 13p. (HEPL-341; ITP-133). CFSTI.

A recent measurement of the differential cross section for the photoproduction of neutral pi mesons from hydrogen at energies of 660, 680, 700, 720, 740, 760, and 780 MeV, using the linear accelerator, has revealed an anomaly in the angular distributions in the region of high momentum transfer (backward region). It is shown that the observed enhancement may be interpreted as due to the effect of the crossed nucleon and crossed pion-nucleon isobar exchanges which contribute to this process. Previous analyses have assumed that such effects are negligible. (auth) (USGRDR)

34825 (AD-665851) PHOTOPRODUCED AND ELECTROPRODUCED MUON PAIRS. Physical Sciences Research Papers No. 348. Rothwell, Paul L. (Academy of Natural Sciences of Philadelphia, Pa.). Dec. 1967. 91p. (AFCRL-67-0674). CFSTI.

Photoproduced muon pairs were measured between 470 and 1070 MeV in invariant mass. The results, after suitable corrections, were compared with the predictions of quantum electrodynamics. A value of (0.74 plus or minus 0.20) × 10 to the -4th power was obtained for the rho branching ratio into muon pairs compared with pion pairs. Upper limits of 0.26 and 0.12 were obtained for the omega and phi decay into muon pairs compared to the rho. The differential cross section for electroproduced (elastic) muon pairs were calculated including the cross terms between the space-like and time-like diagrams. The cross sections were evaluated for regions where either the space-like or time-like terms dominate. The muon-produced electron pair cross sections were also considered. Integration was performed over the final electron for muon pairs and the final muon for electron pairs. A region is shown to exist, consistent with Yamamoto's work, where the time-like case dominates. Counting rates are given for the apparatus for a carbon target and including form factor effects. Finally, zero mass, small angle approximations are derived for the differential cross sections for equal pair energies. (auth) (USGRDR)

34826 (AD-666979) FORM FACTOR OF THE NEUTRAL PION. Nemethy, Peter (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). 1968. Contract Nonr-266(72). 74p. (R-617; NEVIS-165). CFSTI.

In an experiment performed at the cyclotron, the decay of a neutral-pion to gamma photon + electron + positron was observed. Using a system of counters and spark chambers 2200 events were recorded with an opening angle of the Dalitz pair near 120 deg. The effect of pi-zero structure on the invariant mass spectrum of the pair is interpreted as an electromagnetic form factor for the neutral-pion. The form factor is a linear function, (gamma) (x) = 1 + ax, of the invariant mass squared, x. The experimental result for the form factor slope is a = (+0.01 plus or minus 0.11) (1/(pion mass)sq.). (USGRDR)

34827 (DESY-68/22) MEASUREMENTS OF SINGLE π^- AND π^+ PHOTOPRODUCTION AT SMALL MOMENTUM TRANSFERS. Heide, P.; Koetz, U.; Lewis, R. A.; Schmueser, P.; Skronn, H. J.; Wahl, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1968. 20p. Dep.

Single π^- and π^+ photoproduction from deuterium was measured at gamma energies from 2.6 to 6 GeV and momentum transfers between 0.005 and 0.6 $(\mathrm{GeV}/c)^2$. The π^-/π^+ ratio is found to be unity near the forward direction and drops to about 0.3 at larger angles. The data support the existence of a forward peak in π^- photoproduction on neutrons. (auth)

34828 (LNF-68/21) TWO PION PHOTOPRODUCTION IN A HYDROGEN BUBBLE CHAMBER BELOW 1000 MeV. Note No. 395. De Schryver, S.; Fiore, L.; Focardi, S.; Gialanella, G.; Rossi, V.; Stella, B.; Susinno, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Apr. 8, 1968. 24p. Dep.

Some preliminary results of an investigation of the double photoproduction reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$ carried out by means of a hydrogen bubble chamber at the electron synchrotron are reported. The main features below 1000 MeV which seem to be experimentally well established are the shape of the total cross section which goes up rapidly with the energy and has a maximum between 650 and 1000 MeV and the formation of the Δ (1236) isobar in the Δ^{++} (π^+p) charge state with a production percentage which is nearly 100% from threshold to 800 MeV and decreases to 70% at 1000 MeV. Also very low production with a percentage consistent with zero of the Δ (1236) isobar in the neutral charge state (π^-p) is found. (J.F.P.)

34829 ELECTROMAGNETIC RADIUS OF THE PION. Block, M. M.; Kenyon, I.; Keren, J.; Koetke, D.; Malhotra, P.; Walker, R.; Winzeler, H. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 169: 1074-6(May 25, 1968).

The elastic differential scattering cross sections, as well as inelastic cross sections, were obtained for both π^+ and π^- on ^{4}He at 129, 140, and 150 MeV/c, using a 50-cm helium bubble chamber. Following the suggestion of Sternheim and Hofstadter, these data were analyzed in order to obtain the Coulomb-nuclear interference term. From this, the Coulomb amplitude is deduced, which gives information on the pion charge distribution. The data are analyzed in terms of (a) Born Coulomb amplitude containing a combined Gaussian form factor for the pion and the α particle, (b) pure nuclear phases, and (c) the distortion of the nuclear phases due to the long-range nature of the Coulomb field. These qualities, along with the corresponding nuclear potentials, suitably fitted to our data, are presented. The rms combined radius of the pion-^{4}He system was measured as $R = 1.1 \pm 0.79$ F. This yields r_π, the rms radius for the pion, to be $r_\pi < 0.9$ F. (auth)

34830 ANGULAR DISTRIBUTIONS FOR π^+ ELECTROPRODUCTION AND THE PION FORM FACTOR. Mistretta, C.; Imrie, D.; Appel, J. A.; Budnitz, R.; Carroll, L.; Goitein, M.; Hanson, K.; Wilson, Richard (Harvard Univ., Cambridge, Mass.). Phys. Rev., Lett., 20: 1523-6(June 24, 1968).

Differential cross-section measurements for the reaction $e^- + p \rightarrow e^- + n + n^+$ in the region of the $N^*(1236)$ resonance are compared with the dispersion theories of Adler and Zagury at four-momentum transfers between 1.2 and 15.3 F^{-2} using the pion form factor as a free parameter. The results suggest a form factor similar to that of the proton. (auth)

34831 DALITZ PLOT ANALYSIS OF THE DECAY $\eta \rightarrow \pi^+\pi^-\pi^0$. Cnops, A. M. (CERN, Geneva); Finocchiaro, G.; Mittner, P.; Duffey, J. P.; Gobbi, B.; Pouchon, M. A.; Mueller, A. Phys. Lett., 27B: 113-16(June 10, 1968).

The Dalitz plot of 7170 decays $\eta \rightarrow \pi^+\pi^-\pi^0$ was fitted with several matrix elements. The slope of a purely real linear matrix element $ME = 1 + \alpha[(3T_0/Q) - 1]$ is $\alpha = -0.55 \pm 0.02$. Upper limits for possible contributions of $\Delta I = 0$ and $\Delta I = 2$ C-violating amplitudes are given. (auth)

34832 ACCURATE DETERMINATION OF THE TOTAL PAIR PRODUCTION CROSS SECTION IN CARBON, ALUMINIUM, COPPER, AND LEAD·FOR PHOTONS FROM 1.2000 TO 4.050 GeV. Knasel, T. M.; Walker, J. K. (Harvard Univ., Cambridge, Mass.). Contract AT(30-1)-2752. Phys. Lett., 27B: 103-5(June 10, 1968).

The total pair production cross section for photons of energies 1.200 to 4.050 GeV was measured for targets of carbon, aluminum, copper, and lead by a good geometry absorption technique. The accuracy of the work is ±0.3%. (auth)

34833 MEASUREMENTS ON INELASTIC ELECTRON-PROTON SCATTERING. Brasse, F. W.; Engler, J.; Ganssauge, E.; Schweizer, M. (Deutsches Elektronen-Synchrotron, Hamburg). Nuovo Cim., 55A: 679-89(June 21, 1968).

Using the internal beam of DESY inelastic electron-proton cross sections were measured at various angles between 32.3° and 75° for the scattered electron, and with momentum transfers of about 20, 40 and 60 fm^{-2} to the first (π,N) resonance. The experimental set-up was nearly the same as used for earlier measurements on elastic e-p, and e-d scattering. The analysis of the data at the first resonance shows agreement with dispersion-theoretic calculations. In the region of the second and third resonance the cross sections do not follow the threshold behavior but show a surprising dependence on $|p|$, the 3-momentum transfer to the proton. (auth)

34834 DECAY MODES OF THE ETA MESON. Cox, Bradley Burton. Durham, N. C., Duke Univ., 1967. 135p.

Thesis.

Branching ratios are obtained for the decay modes of the meson: $\eta \rightarrow \gamma\gamma$ $\eta \rightarrow \pi^0 \pi^0 \pi^0$ $\eta \rightarrow \pi^+ \pi^- \pi^0$ $\eta \rightarrow \pi^+ \pi^- \gamma$ by examining a sample of η's produced in the interaction $K^- p \rightarrow \eta \Lambda^0$ at 740 Mev/c in the 30 inch bubble chamber. (TSS) (Disser. Abstr.)

Weak

Refer also to abstract 35214.

34835 ENERGY DEPENDENCE OF THE FORM FACTOR IN K^+_{e3} DECAY. Imlay, Richard Larry. Princeton, N. J., Princeton Univ., 1967. 71p.

Thesis.

The decay $K^+ \rightarrow e^+ + \pi^0 + \nu$ was investigated in a spark chamber and counter experiment. The K^+ mesons were stopped in a block of beryllium. A threshold gas Čerenkov counter was employed to select the positronic decay mode and the positron momentum was obtained with a series of thin plate spark chambers located in a magnetic field between the K^+ stopping region and the Čerenkov counter. The directions of the gamma rays from the π^0 decay were measured with a pair of lead plate spark chambers. A Dalitz plot of 1393 K^+_{e3} events agrees well with vector coupling. The π^0 energy spectrum was investigated to determine the energy dependence of the strong interaction form factor $f_+(q^2)$ where q^2 is the square of the four momentum transferred to the leptons and equals $M_k^2 + M_\pi^2 - 2M_kE_\pi$ for K^+ decays at rest. For a linear expansion $f_+(q^2) = f_+(0)(1 + \lambda q^2/M_\pi^2)$, one obtains $\lambda = 0.016 \pm 0.016$, which agrees well with previous measurements of λ for K^+_{e3}. Assuming the interaction is dominated by a $J = 1^-$, $I = 1/2$ intermediate state of mass M, such as the K^* resonance at 890 MeV, one obtains $M = (1180^{+\infty}_{-387})$ MeV. This result is consistent with K^* dominance but also with no energy dependence for f_+. The value of λ for K^+_{e3} obtained agrees with the weighted value $\langle\lambda^0\rangle = 0.010 \pm 0.018$ obtained from four K^0_{e3} experiments and thus offers no evidence for violation of the leptonic $|\Delta I| = 1/2$ rule. (Diss. Abstr.)

34836 LIFETIME OF Λ^3H. Phillips, R. E.; Schneps, J. (Tufts Univ., Medford, Mass.). Phys. Rev. Lett., 20: 1383-6 (June 10, 1968).

In a nuclear-emulsion experiment to determine the lifetime of ${}_{\Lambda}H^3$ a value is found consistent with that of the free Λ hyperon as predicted by theory, and not in good agreement with a previous measurement. (auth)

34837 MUON DECAY DEEP UNDERGROUND. Kropp, W. R. Jr. (Univ. of California, Irvine); Reines, F.; Woods, R. M. Jr. Phys. Rev. Lett., 20: 1451-2(June 17, 1968).

A measurement of delayed coincidences characteristic of muon decay was made at a depth of 1440-hg/cm^2 standard rock with a 200-liter liquid scintillation detector. These results are consistent with the decay rate predicted from the depth-intensity curve for the penetrating component of the cosmic rays, providing independent evidence that this component is energetic muons. (auth)

34838 DETERMINATION OF THE BETA DECAY RATE OF THE SIGMA HYPERON AND THE $\Delta S = \Delta Q$ RULE. Bierman, E.; Kounosu, S.; Nauenberg, U.; Seidlitz, L. (Princeton Univ., N. J.). Phys. Rev. Lett., 20: 1459-62(June 17, 1968).

The branching ratio for the electronic decay of the Σ^- was found to be $R(\Sigma^- \rightarrow n + e^- + \overline{\nu})/R(\Sigma^- \rightarrow n + \pi^-) = (1.11 \pm 0.09) \times 10^{-3}$. Similarly, in a measurement of 5×10^4 $\Sigma^+ \rightarrow n + \pi^+$ decays no example of decays of the type $\Sigma^+ \rightarrow n + e^+ + \nu$ or $\Sigma^+ \rightarrow n + \mu^+ + \nu$ was found. This gives an upper limit of 6.3% (90% confidence level) on the relative rate $R(\Delta S = -\Delta Q)/R(\Delta S = +\Delta Q)$ for the process in this experiment. (auth)

34839 THE MASS DIFFERENCE OF K_1^0- AND K_2^0-MESONS. Balats, M. Ya.; Berezin, V. M.; Vishnevskii, M. E.; (and others). Yadern. Fiz., 7: 217-9(1968). (In Russian).

K_1^0-mesons were obtained during coherent generation in an aluminum generator placed in a beam of K_2^0-mesons. The intensity of the $K^0 \rightarrow \pi^+\pi^-$ decays behind the generator as a function of the generator length (Al generators had lengths of 7, 15, 25, 35, 45, and 55 cm) was measured on a magnetic spectrometer with spark chambers. On comparing the intensity of the $K^0 \rightarrow \pi^+\pi^-$ decays for generators of different length it is possible to find the mass difference of the K_1^0- and K_2^0-mesons $\delta = (m_1 - m_2)/(1/\tau_1)$. After treating a total of 2000 events, the value of δ was found to be 0.53. The lifetime of the K_1^0-meson was taken as equal to $\tau_1 = 0.895 \times 10^{-10}$ sec. (TTT)

34840 STUDY OF A NEW RESONANCE. Kuznetsov, A. A. (Joint Inst. of Nuclear Studies, Dubna, USSR). Priroda, No. 1, 82-4(Jan. 1968). (In Russian).

After a short description of subnuclear particles of short lifetime, a resumé is given of the studies beginning in 1963 of resonances whose products might be Λ^0 particles and γ quanta. A description of the synchrophasotron at Dubna is given, with an illustration of the bubble chamber, magnets, and lenses used for detection of the products. A discussion of some of the minor points of interest in the photographs is given. Then, with reference to the effective-mass spectrum of the particle systems, a peak is found corresponding to a resonance decaying to a Λ^0 hyperon and an η^0 meson. The resonance was first noted by B. L. Ioffe in 1962, and expounded at the 1964 conference in Dubna. The inclusion of this species in the organization of Gell-Mann is discussed. (BBB)

Strong (Baryon-Induced)

34841 (COO-1112-155) SEARCH FOR STABLE FRACTIONALLY CHARGED PARTICLES. Rank, David M. (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 84p. Dep. CFSTI.

Thesis.

A search for stable fractionally charged particles called quarks is described. These particles form an elegant yet simple model which can explain the SU_3 symmetry of strongly interacting particles. Three different quarks and their corresponding antiparticles with charges $\pm 1/3 e$ $\pm 2/3 e$ are required by the theory. Three quarks bound together in relative S states produce a baryon and a quark–antiquark combination produces a meson. All known strongly interacting particles can be formed from combinations of these six quarks. Atoms formed with a $+2/3$ quark as a nucleus and an electron were sought with the aid of optical spectroscopy by an attempt to observe their Lyman series. Various substances were examined: sea water, lake water, seaweed, oysters, and plankton. With the aid of concentration techniques involving distillation in the presence of an electric field, limits were set on the concentration of quarks in these substances by the null result. For lake water and sea water, the concentration of $+2/3$ quarks was $\leq 1 : 10^{18}$ quarks/nucleon; for the biological samples, the concentration of $+2/3$ quarks was $\leq 1 : 10^{17}$ quarks/nucleon. A second series of experiments which attempted to detect fractional charges on oil drops also yielded a null result. Various oils were used: mineral oil, soya bean oil, peanut oil, and cod-liver oil. The null result indicated that the concentration of quarks in these oils was $\leq 3 : 10^{20}$ quarks/nucleon. (auth)

34842 (ORNL-tr-1924) PRODUCTION OF CHARGED PIONS IN COLLISIONS OF NEUTRONS OF 600 MeV ENERGY WITH NUCLEI OF VARIOUS ELEMENTS. Oganesyan, K. O. Translated for Oak Ridge National Lab., Tenn., from report JINR-P1-3399. 19p. Dep. CFSTI.

The production of charged pions in neutron–nucleus collisions was studied by means of a magnetic spectrometer in a broad angular interval. Investigations were carried out on nuclei of beryllium-9, carbon-12, aluminum-27, copper-64, and lead-207 in the neutron beam of a synchrocyclotron. The various cross sections, spectra, and angular distributions are shown. (J.F.P.)

34843 PROTON–PROTON TRIPLE SCATTERING AT 430 MeV. Limon, P. (Univ. of Wisconsin, Madison); Pondrom, L.; Olsen, S.; Kloeppel, P.; Handler, R.; Wright, S. C. Contract AT(11-1)-881. Phys. Rev., 169: 1026-33(May 25, 1968). (COO-881-148).

The Wolfenstein parameters D, R, A, R′, and A′, and the polarization P were measured at 430 MeV and 65° in the cm system, and D, R, A, and R′ + A′ were measured at 115° in the cm system. The equations relating these observables to the complex amplitudes of the p-p spin matrix were solved for the amplitudes. The results agree well with amplitudes calculated from a phase-shift analysis which includes p-p scattering data at several energies and angles. (auth)

34844 SPIN–PARITY ANALYSIS OF THE B MESON. Ascoli, G.; Crawley, H. B.; Mortara, D. W.; Shapiro, A. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 20: 1411-14(June 17, 1968).

From the decay distribution and the polarization of the ω in $B \rightarrow \omega\pi$, the B is found to have either $J^P = 1^+$ or $J^P = 2^+3^-4^+ \ldots$. The observed polarization of the B appears more plausible for the $J^P = 1^+$ hypothesis. (auth)

34845 Λp INTERACTION NEAR ΣN THRESHOLD. Cline, D.; Laumann, R.; Mapp, J. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 20: 1452-5(June 17, 1968). (COO-881-165).

The conversion process $\Sigma^+n \rightarrow \Lambda p$ was observed using the sequence $K^-d \rightarrow \pi^-(\Sigma^+n) \rightarrow \pi^-(\Lambda p)$. The results of this study are that (1) the conversion process at very low energy is dominated by the (ΣN) triplet state; and (2) the reaction is strongly enhanced for Λp masses below Σ^+n threshold, suggesting the existence of a bound state in the Σ^+n system and, hence, an elastic resonance in the Λp system. (auth)

34846 PRODUCTION OF FAST DEUTERONS AND TRITONS IN HIGH-ENERGY NUCLEAR INTERACTIONS. Bharadwaj, P. D.; Jain, P. L. (State Univ. of New York, Buffalo). Nuovo Cim., 55A: 765-79(June 21, 1968).

The production of fast deuterons and tritons by three primary beams of 6.2 GeV/c protons, 16.2 GeV/c pions and 28 GeV/c protons was investigated in nuclear emulsion. The experimental results, for the production of deuterons and tritons in the momentum range of 1 to 5 GeV/c are presented and the possible mechanisms for their production are discussed. (auth)

34847 KOSMICHESKIE LUCHI I IKH VZAIMODEISTVIE. (Cosmic Rays and Their Interactions). Murzin, V. S.; Sarycheva, L. I. Moscow, Atomizdat, 1968. 392p.

Experimental data obtained on nuclear interactions of cosmic particles are discussed. Characteristics of elementary nuclear interaction processes at energies from 10 to 10^5 GeV are analyzed, and properties of cosmic rays are described. Cross sections of nuclear active particle interactions multiplicity and the nature of secondary particles, their energy and angular distribution are discussed. Data obtained by direct recording of cosmic particle interactions, or secondary phenomena produced by particles of superhigh energy in the atmosphere are correlated and compared with the data obtained with simulated models. 503 references are included. (R.V.J.)

Strong (Meson-Induced)

Refer also to abstracts 34834, 34841, 34846, and 35292.

34848 (NP-17481) THE NON-MESONIC DECAY OF HELIUM HYPERNUCLEI. Bulletin No. 35. Coremans, G.; Sacton, J.; Davis, D. H.; Allen, J. E.; Fishwick, A. (Brussels Univ. (Belgium)). Apr. 1968. 15p. Dep.

The nonmesonic decays of hypernuclei which emit two charged particles were analyzed. The events were produced in absorption of K^- mesons at rest in nuclear emulsions. From a knowledge of the numbers of π^--mesonic decays of various species found from the same sample of K^- meson capture stars and also the nonmesonic decay parameters deduced from ${}_\Lambda He^4$ decays in a helium bubble chamber, an attempt was made to determine the rates of the different nonmesonic decay modes of the ${}_\Lambda He^5$ hypernucleus. Some properties of the ${}_\Lambda He^5 \rightarrow {}^1H^3Hn$ process are established. (auth)

34849 (NYO-3178-5) RESEARCH IN ELEMENTARY PARTICLE PHYSICS. Technical Progress Report, March 31, 1968. Kirsch, Lawrence (Brandeis Univ., Waltham, Mass. Dept. of Physics). Contract AT(30-1)-3178. 6p. Dep. CFSTI.

The experimental study of elementary particle interactions using bubble chambers as detectors is reported. Experiments either proposed or under analysis are briefly summarized and include the neutral branching ratios of the eta meson, $K^- + N$ interactions with center of mass energies between 1690 and 1750 MeV, the $K^- + p$ interaction at 2.9 GeV/c, and $K^- + d$ interactions at 920 MeV/c for the study of the reaction $K^- + n \rightarrow \Sigma^- + \eta^0$. (J.F.P.)

34850 PART ONE: THE REACTION $K^-d \rightarrow \bar{K}^0$ nn, FROM THRESHOLD TO 300 MeV/c. PART TWO: K^+p ELASTIC SCATTERING: 80 TO 280 MeV/c. Lansford, Robert Maurice. Urbana, Ill., Univ. of Illinois, 1967. 101p. Thesis.

The cross section for the reaction $K^-d \rightarrow \bar{K}^0$ nn was measured for the laboratory momentum interval from threshold (96.7) to 300 MeV/c. The cross section is found to rise quickly above threshold to around 6 mb at 150 MeV/c, then decrease slowly from 150 to 300 MeV/c. The experimental values are found to be consistently lower (about 20%) than the recent values calculated by Hetherington and Schick using Faddeev techniques. An experiment was also performed using the 15 inch hydrogen bubble chamber to measure the low energy K^+p elastic scattering cross section. Although the differential cross section is generally lower than those obtained by Stubbs, the experiments are consistent to within the quoted experimental errors. (Disser. Abstr.)

34851 ENERGY ESTIMATION OF PHOTON CASCADE SHOWERS APPLIED TO $\pi^- + p \rightarrow n + \gamma$ AT 1.5 GeV/c. Hargraves, Robert Frederick Jr. Providence, Brown Univ., 1967. 121p. Thesis.

An experiment was performed which studied the reaction $\pi^- + p \rightarrow$ neutrals by means of spark chambers designed to detect photons. The laboratory momentum of the incident pion was 1.5 GeV/c. The four spark chambers each consisted of 50 plates of 0.113 radiation length of iron. Showers in the spark chambers were induced by photons from π^- interacting in the hydrogen target. The energies of the showers were estimated by counting the numbers of sparks observed in the gaps. The estimated energies of the showers were adjusted to satisfy the kinematical constraints of a particular hypothesis of particle production. This procedure was applied to several reactions to determine cross sections: $\pi^- + p \rightarrow n + \pi^0$ (1160 μb ± 10%), $\pi^- + p \rightarrow n + (\eta^0 \rightarrow \gamma + \gamma)$ (153 μb ± 24%), $\pi^- + p \rightarrow n + (\omega^0 \rightarrow \pi^0 + \gamma)$ (168 μb ± 18%), and $\pi^- + p \rightarrow n + \pi^0 + \pi^0$ (360 μb ± 16%). In the last reaction the $\pi^0\pi^0$ interaction was studied and compared to the predicted resonances σ^0(400 MeV) and ϵ^0(700 MeV). There was evidence of the formation of 3-3 isobar $N^*(1236)$. (Diss. Abstr.)

34852 DATA ON RESONANCE WITH MASS ~1300 MeV IN $K^0\bar{K}^0$ SYSTEM. Demidov, V. S.; Kirillov-Ugryumov, V. G.; Ponosov, A. K.; Protasov, V. P.; Sergeev, F. M. Yadern. Fiz., 7: 470-1(Feb. 1968). (In Russian).

The effective mass distribution of $K_1^0K_1^0$-pairs, which are formed during the interaction of π^--mesons (having an average momentum of 3.86 GeV/c) with light nuclei, was investigated by scanning about 80,000 photographs obtained on a 105-cm freon bubble chamber irradiated with protons from a synchrotron. The effective mass distribution was obtained from a total of 120 events. The accuracy in determining the mass was 20 MeV or better. The average value of the mass of the resonance was found to be 1280 ± 20 MeV with a width $\Gamma \approx 50$ MeV. The resonance has a spin different from zero, most probably 2^+. The results can be interpreted by the appearance of the following decay: $A_2 \rightarrow K^0 + \bar{K}^0$. (TTT)

34853 STUDY OF $K^-p \rightarrow \bar{K}N\pi$ REACTIONS AT 1.33 GeV/c. Ficenec, J. R.; Hulsizer, R. I.; Swanson, W. P.; Trower, W. P. (Univ. of Illinois, Urbana). Phys. Rev., 169: 1034-44(May 25, 1968).

The reactions $K^-p \rightarrow \bar{K}N\pi$ at 1.33 GeV/c are found to be dominated by $\bar{K}^*(890)N$ production. Some evidence is also found for $N^*(1236)\bar{K}$ and $Y_0^*(1520)\pi$ production. Slight amounts of $Y_1^*(1765)\pi$ are seen. An investigation of the angular distributions of events in the $\bar{K}^*(890)$ mass region was made. A backward peaking exists in the production angular distribution of $\bar{K}^{*-}p \rightarrow \bar{K}^0\pi^-p$. No evidence for this backward peaking is found in the other $\bar{K}^*N$ final states. Both production and the decay angular distributions of the $\bar{K}^*(890)$ indicate that the $\bar{K}^{*0}n$ final state can be explained by an exchange of a pseudoscalar meson of small mass. In the $\bar{K}^{*-}p$ final states, the exchange of an isotopic spin-zero vector meson as well as a pseudoscalar meson explains the data. (auth)

34854 STUDY OF Y_1^* RESONANT AMPLITUDES BETWEEN 1660 AND 2215 MeV IN THE REACTION $K^-N \rightarrow \Lambda\pi$. Smart, Wesley M. (Univ. of California, Berkeley). Phys. Rev., 169: 1330-8(May 25, 1968). (UCRL-17956).

The partial-wave analysis of the reaction $K^-N \rightarrow \Lambda\pi$ was extended from our data in the energy region 1660 to 1900 MeV to the data at higher energies (1900 to 2215 MeV) from other experiments. This analysis has established the resonant nature of $Y_1^*(1910)$ and measured its spin and parity as $J^P = 5/2^+$. The earlier assignment $J^P = 7/2^+$ for $Y_1^*(2030)$ by Wohl et al., has been confirmed. The mass, width, and $\Lambda\pi$ branching ratio were measured as 1902 ± 11 MeV, 52 ± 25 MeV, and 0.08 ± 0.04 for $Y_1^*(1910)$, and 2032 ± 6 MeV, 160 ± 16 MeV, and 0.41 ± 0.03 for $Y_1^*(2030)$. In addition we found a suggestion for the existence of a $J^P = 1/2^+$ resonance at 1880 MeV with a width of 220 MeV. (auth)

34855 $\bar{p}p$ ANNIHILATIONS AT REST INTO $\pi^+\pi^-\pi^0$. Gelfand, Norman M. (Univ. of Chicago). Phys. Rev., 169: 1077-80 (May 25, 1968).

The reaction $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ was studied for antiprotons stopped in the Columbia-Brookhaven National Laboratory 30-in. bubble chamber. For this reaction, 1193 events were selected after applying stringent criteria to reduce the contamination of the sample. Analysis of the distribution of events on the Dalitz plot shows a $\rho\pi$ contribution in addition to the dominant 3π contribution from the ${}^1S_0$ $\bar{p}p$ state. The annihilation from the ${}^3S_1$ $\bar{p}p$ state has contributions from both a $\rho\pi$ and 3π final states. (auth)

34856 MEASUREMENTS OF TOTAL CROSS SECTIONS FOR K_2^0 MESONS ON PROTONS AND SELECTED NUCLEI FROM 168 TO 343 MeV/c AND MEASUREMENT OF THE K_2^0 MEAN LIFE. Sayer, G. A. (Univ. of Maryland, College Park); Beall, E. F.; Devlin, T. J.; Shepard, P.; Solomon, J. Contract AT(40-1)-2504. Phys. Rev., 169: 1045-73(May 25, 1968). (ORO-2504-115).

K_2^0-p total cross sections were measured for K_2^0 laboratory momenta between 168 and 343 MeV/c. From these data the isotopic spin-1 $\overline{K}N$ s-wave scattering length was determined to be $(0.00 \pm 0.14) \pm i(0.62 \pm 0.06)$ F. This is in fair agreement with previous determinations. K_2^0-nuclear total cross sections were also measured for seven species of nuclei which span the periodic table, in the same momentum range, to statistical accuracies of typically a few percent in each of eleven momentum intervals within the range. The data at the highest momentum do not obey an A^{δ} law. The K_2^0 mean life was found to be $(5.15 \pm 0.14) \times 10^{-8}$ sec. This is in agreement with previous results and represents an improvement in statistical accuracy by about a factor of 3. K_2^0 and γ production was studied at 93° by 2.8-GeV protons on 1.5-in. platinum. The experiment was performed using a scintillation-counter K_2^0 detector. Kinematic identification of each K_2^0 particle was made using a time-of-flight method: The bunched time structure of the internal proton beam of the Princeton-Pennsylvania accelerator was used to determine K_2^0 production times, and an electronic chopping technique was used to eliminate unwanted proton bunches. Depending upon beam conditions, between 10^3 and 10^4 useful K_2^0 mesons per hour were detected with momentum resolution of a few percent. In conjunction with the timing calibration of the system, we have made a direct velocity measurement of the relativistic limiting speed for electrons. The result is $(1 - \beta_{max}) = 0.005 \pm 0.005$. (auth)

34857 COHERENT PRODUCTION OF THE Q AND L MESONS OFF DEUTERIUM. Denegri, D.; Callahan, A.; Ettlinger, L.; Gillespie, D.; Goodman, G.; Luste, G.; Mercer, R.; Moses, E.; Pevsner, A.; Zdanis, R. (Johns Hopkins Univ., Baltimore). Phys. Rev. Lett., 20: 1194-8(May 20, 1968). (TID-24338).

Abundant production of the established L meson and also of the possible Q meson are observed in coherent production, $K^- + d \rightarrow K^- + \pi^+ + \pi^- + d$ at 12.6 GeV/c. This is the first observation of L-meson production on nuclei. The Q and L isospins are unambiguously determined to be ½. The L is observed to be produced polarized. A striking resemblance between the final states $K^*(980)\pi d$ and $K^*(1400)\pi d$ is observed with these final states being related to the Q and L mesons, respectively. (auth)

34858 PROPERTIES OF THE g MESON. Johnston, T. F. (Univ. of Toronto); Prentice, J. D.; Steenberg, N. R.; Yoon, T. S.; Garfinkel, A. F.; Morse, R.; Oh, B. Y.; Walker, W. D. Phys. Rev. Lett., 20: 1414-17(June 10, 1968).

The g meson was observed in $\pi^+\pi^-$, $\pi^-\pi^0$, and $\pi^-\pi^-\pi^+\pi^0$ mass spectra and measured masses, widths, and some branching ratios were measured. The angular distributions and total cross sections presented strongly indicate a J^P of 3^- for the g meson. (auth)

34859 π^-p ELASTIC SCATTERING NEAR 180° AT 8 AND 16 GeV/c. Anderson, E. W. (Brookhaven National Lab., Upton, N. Y.); Bleser, E. J.; Blieden, H. R.; (and others). Phys. Rev. Lett., 20: 1529-32(June 24, 1968).

Differential cross sections are reported for π^-p elastic scattering near 180° at incident pion momenta of 8 and 16 GeV/c. For $|u| < 0.5\ (GeV/c)^2$ the formula $d\sigma/du = A \exp(Bu)$ fits the data very well. At 8 GeV/c, $A = 3.75 \pm 0.35\ \mu b/(GeV/c)^2$ and $B = 3.16 \pm 0.24\ (GeV/c)^{-2}$. At 16 GeV/c, $A = 0.91 \pm 0.13\ \mu b/(GeV/c)^2$ and $B = 4.23 \pm 0.40\ (GeV/c)^{-2}$. A Regge-pole model fit to these data gives for the Δ_δ trajectory $\alpha(u) = (-0.06 \pm 0.12) + (0.8 \pm 0.3)u$. (auth)

34860 MEASUREMENT OF THE PARTIAL WIDTH OF THE DECAY $\phi \rightarrow e^+ + e^-$. Binnie, D. M. (Imperial Coll. of Science and Tech., London). Duane, A.; Faruqi, A. R.; (and others). Phys. Lett., 27B: 106-9(June 10, 1968).

Evidence is presented for the process $\pi^- + p \rightarrow \phi + n$ followed by $\phi \rightarrow e^+ + e^-$. The branching ratio $(\phi \rightarrow e^+ + e^-)/(\phi \rightarrow \text{total})$ is found to be $(7.2 \pm 3.9) \times 10^{-4}$, corresponding to a partial width for $\phi \rightarrow e^+ + e^-$ of $2.4 \pm 1.5\ keV/c^2$ and a coupling constant $\gamma_\phi^2/4\pi$ of $1.9^{+1.7}_{-0.7}$. (auth)

34861 ANALYSIS OF THE K(1300) SYSTEM PRODUCED IN 5.5-GeV/c K^+p INTERACTIONS. Bomse, F.; Borenstein, S.; Callahan, A.; (and others) (Johns Hopkins Univ., Baltimore). Phys. Rev. Lett., 20: 1519-22(June 24, 1968).

An analysis was made of 6500 events of the $K^+p \rightarrow K^+\pi^-\pi^+p$ reaction and 900 events of the $K^+p \rightarrow K^0\pi^+\pi^0p$ reaction from a bubble chamber exposure to a K^+ beam at 5.5 GeV/c. The diffraction-dissociation model was applied to the analysis of the $K^*(890)\pi$ system. It is found that the model (without form factors) gives reasonable results for the K^* decay distribution but fails to fit the $K^*\pi$ mass distribution. The spin and parity properties of the 1300-MeV $K^*\pi$ enhancement were also studied and were found to be predominantly 1^+. (L.B.S.)

34862 KAONIC DISINTEGRATION OF THE DEUTERON NEAR 400 MeV/c. Cline, D.; Laumann, R.; Mapp, J. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Lett., 27B: 110-12 (June 10, 1968). (COO-881-166).

The processes $K^-d \rightarrow \Sigma^-p$ and $K^-d \rightarrow \Lambda n$ were observed at K^- momenta of 340 MeV/c and 400 MeV/c. The cross sections for these processes are: $\sigma(\Sigma^-p) = 200 \pm 30\ \mu b$ at 400 MeV/c, $\sigma(\Lambda n) = 200 \pm 30\ \mu b$ at 400 MeV/c, $\sigma(\Sigma^-p) = 300 \pm 100\ \mu b$ at 340 MeV/c, $\sigma(\Lambda n) = 360 \pm 150\ \mu b$ at 340 MeV/c. (auth)

34863 ANALYSIS OF MULTI-PRONG EVENTS IN PION-NUCLEON INTERACTIONS AT AN ENERGY OF 17 GeV. Anzon, Z. V.; Vinitskii, A. Kh.; Izbasarov, M.; Strel'tsov, I. S.; Takibaev, Zh. S.; Chasnikov, I. Ya.; Shakhova, Ts. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 13-16(Nov.-Dec. 1967). (In Russian).

An analysis was made of the momentum and angular characteristics of secondary particles from interactions with the number of prongs ≥7 in nuclear emulsion. The angular distribution of π mesons in the center of mass is asymmetric with the preferred expulsion in the forward direction. The asymmetry coefficients obtained agree well with the assumption that the primary π meson maintains its direction of movement. Protons in the center of mass are expelled in the backward direction, that is have the same distribution character as in small multiplicity. In the distribution on the square of the four momentum transferred to the nucleon of the target both for pion-proton and pion-neutron interaction, the maxima appear in region of $0.2\ (GeV)^2$ and $2.6\ (GeV)^2$. The results obtained can not be described even qualitatively by the statistical theory of multiple production. (tr-auth)

34864 ANGULAR DISTRIBUTION OF SECONDARY PIONS IN π^--N COLLISIONS AT 17 GeV ENERGY. Azimov, S. A.; Nikishin, B. K.; Rechitskii, I. V.; Chudakov, V. M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 4, 20-2(1967). (In Russian).

The inelastic π^--p interaction with free and quasifree protons was experimentally studied by irradiated Ilford G5 emulsions with π^- mesons at 17.2 GeV/c. Interactions with three and five secondary particles and a slow recoil proton were analyzed, and the angular distribution in the cms was calculated. The results showed with sufficiently rigid energy spectra of the secondary pions the ultrarelativistic approximation gives completely reliable results, but with a very soft spectrum it leads to the appearance of a small forward asymmetry. (J.S.R.)

34865 BACKWARD π^+-p ELASTIC SCATTERING AT HIGH ENERGY. Minami, S. (Osaka City Univ.). Nuovo Cim., 55A: 738-49(June 21, 1968).

Backward π^+-p elastic scattering at 1.7 to 7.8 GeV/c is described in terms of the resonant amplitude and the nucleon-exchange amplitude. It is shown that experimental results for $d\sigma/d\Omega$ in the backward direction can be fairly well explained without the Regge-pole theory. For the polarization of recoil protons in backward π^+-p scattering at 2 to 4 GeV/c, there is a large difference between these results and the predictions obtained by adding the resonant amplitude and Regge exchange amplitude. Polarization measurements give us important information concerning the theory by which high-energy phenomena can be well described. (auth)

34866 PRODUCTION OF NEUTRONS IN Pb, Cd, Fe, AND Al INDUCED BY COSMIC μ MESONS AT A DEPTH OF 150 m WATER-EQUIVALENT. Gorshkov, G. V.; Zyabkin, V. A. Yadern, Fiz., 7: 770-7(Apr. 1968). (In Russian).

Neutron production in Pb, Cd, Fe, and Al induced by cosmic μ mesons at a depth of 150 m water-equivalent (the mean muon energy is about 40 GeV) was measured. The average values of product of the interaction cross section by the neutron multiplicity calculated per nucleon, are found to be $\sigma\nu/A = (192 \pm 18) \cdot 10^{-29}\ cm^2$/nucleon for Pb, $(171 \pm 71) \cdot 10^{-29}\ cm^2$/nucleon for Cd, $(55 \pm 16) \cdot 10^{-29}\ cm^2$/nucleon for Fe and $(43 \pm 29) \cdot 10^{-29}\ cm^2$/nucleon for Al. The conclusion is made that the main contribution to the neutron production induced by cosmic rays at the depth in view is from the high-energy muons. The total velocities of the neutron production in Pb, Cd, Fe, and Al equal to $(0.294 \pm 0.029) \cdot 10^{-6}$, $(0.27 \pm 0.11) \cdot 10^{-6}$, $(0.093 \pm 0.025) \cdot 10^{-6}$ and $(0.079 \pm 0.042) \cdot 10^{-6}$ neutron/g · sec, respectively. (auth)

Particle Interactions and Properties (Theoretical)

General

34867 (DESY-68/19) STROMALGEBRA. (Current Algebra). Stichel, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr. 1968. 19p. (In German). Dep.

A short review of the content of current algebra, its main results, and its role within present elementary particle physics is given. (auth)

34868 (JINR-E2-3799) HYPOTHESIS OF COMMUTATIVE SUPERSELECTION RULES. Kharatyan, S. G.; Oksak, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 10p. Dep.

The hypothesis of commutative superselection rules is a consequence of the assumption: the linear hull of the set of physically realizable vectors is dense in the Hilbert space. (auth)

34869 (NP-17483) ON THE GROUP THEORETICAL APPROACH TO THE CONSPIRACY PROBLEM FOR ARBITRARY MASSES. Note No. 158. Cosenza, G.; Sciarrino, A.; Toller, M. (Rome Univ. (Italy). Istituto di Fisica). Feb. 12, 1968. 116p. Dep.

The scattering amplitude for an arbitrary two-particle process is written as a function $Tm_1^W m_2 m_3 m_4(h)$ where W is the square of the four-momentum transfer and h is an element of a subgroup H_W^c of the complex Lorentz group. If suitable conventions are used, this function is shown to be free of kinematic singularities and free of kinematic constraints apart from two covariance conditions of group theoretical nature. The usefulness of this function in the treatment of the kinematic conditions in a Regge pole model is shown and discussed. The matrix elements of the representations of the homogeneous Lorentz group are used in order to obtain explicit expressions for this function, which satisfy, above a certain energy, all the requirements of analyticity and covariance. These expressions are equivalent to the contribution of a family of parallel conspiring Regge trajectories with well-defined quantum numbers. Both equal and unequal mass reactions are considered. The factorization properties of the Regge residues are satisfied for an arbitrary number of reactions involving arbitrary masses and spins. These solutions of the kinematic conditions are not sufficiently general for the physical applications, but have many features which should be present in the physically relevant solutions. (auth)

34870 REPRESENTATION THEORY OF LOCAL CURRENT ALGEBRAS. Roffman, Eric H. (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.), 8: 1954-6(Oct. 1967).

The following theorem is proven: Every finite-dimensional irreducible representation of the local current algebra $[F_\rho(k_1), F_\sigma(k_2)] = e_{\rho\sigma}^{\tau} F_\tau(k_1 + k_2)$, where the $\{e_{\rho\sigma}^{\tau}\}$ are the structure constants of a semisimple Lie algebra L, has the form $F_\rho(k) \rightarrow \Sigma_{i=1}^{N} e^{ikx_i} T_\rho^i$, where T_ρ^i is a finite-dimensional representation of L, and for $i \neq j$, $x_i \neq x_j$; T_ρ^i commutes with T_σ^j for all ρ and σ. (auth)

34871 SYSTEMS OF OBSERVABLES IN AXIOMATIC QUANTUM MECHANICS. Gudder, Stanley (Univ. of Wisconsin, Madison). J. Math. Phys. (N. Y.), 8: 2109-13(Oct. 1967).

Systems of observables are considered in an axiomatic framework for quantum mechanics which generalizes the usual Hilbert space formulation. Familiar concepts such as complete systems of observables and superselection rules are generalized and it is shown that many of the Hilbert space theorems carry over to this abstract formalism. Also functions of observables are considered and some theorems due to John von Neumann are generalized. (auth)

34872 FORMAL PROPERTIES OF THE SOLUTION OF THE RADIATIONLESS RELATIVISTIC KEPLER PROBLEM. Cawley, Robert G. (Clarkson Coll. of Tech., Potsdam, N. Y.). J. Math. Phys. (N. Y.), 8: 2092-6(Oct. 1967).

Formal properties of the solution to the classical radiationless relativistic Kepler problem are discussed with particular attention to the strong coupling limit, a case rarely considered. It is found that fall to the origin can occur for potentials less strongly attractive than required nonrelativistically. One conclusion is that the relativistic centrifugal barrier is less "effective" than the nonrelativistic kind. It is possible to describe these effects in terms of a dimensionless parameter resembling a classical "coupling constant". The quantum-mechanical case is also briefly treated. (auth)

34873 POTENTIAL-CORRELATION FUNCTION DUALITY IN STATISTICAL MECHANICS. De Dominicis, C. (CEN, Saclay, France); Englert, F. J. Math. Phys. (N. Y.), 8: 2143-6(Oct. 1967).

The Feynman path-integral formulation is used to analyze the grand-partition function Z and the n-body Green's function G_n or rather their cumulants (or connected parts) $\tilde{G}_n$ for a system governed by p-body interaction potentials v_p. It is shown that the functional relationship expressing $\tilde{G}_n$ in terms of v_p is invariant under the transformation exchanging $-(-)^m \tilde{G}_m$ and v_m everywhere. Under the same transformation log Z undergoes a change of sign. The content of these results is discussed. (auth)

34874 EVALUATION OF A PARTIAL-WAVE UNITARITY INTEGRAL. Dilley, James (Ohio Univ., Athens). J. Math. Phys. (N. Y.), 8: 2022-5(Oct. 1967).

The integral $\int_{s_+}^{\infty} \rho(s) f(s)\, ds$, where $\rho(s) = (1/s)[(s - s_+)(s - s_-)]^{1/2}$, $0 \leq s_- < s_+$, is evaluated for an arbitrary function f(s) which is meromorphic in the complex s plane and has the behavior at infinity $|s^{1+\epsilon} f(s)| \xrightarrow[|s| \to \infty]{} 0$. Some applications to the N/D method of elementary particle physics are discussed. (auth)

34875 A NECESSARY RESTRICTION ON CORRELATION FUNCTIONS ARISING FROM 3- (OR MORE) PARTICLE SYSTEMS IN ONE DIMENSION. Post, H. R. (Chelsea Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 8: 2154(Oct. 1967).

A necessary condition on any pair-correlation function, arising from the symmetry of a system of three or more identical particles, is derived. (auth)

34876 REMARKS ON THE NATURE OF RELATIVISTIC PARTICLE ORBITS. Kerner, Edward H. (Univ. of Delaware, Newark). J. Math. Phys. (N. Y.), 9: 222-32(Feb. 1968).

Instantaneous action-at-a-distance relativistic particle dynamics, embraced in Newtonian-like equations of motion $\ddot{\chi}_i = F_i(\chi_i, \dot{\chi}_i)$ with suitable F's, is examined in once-integrated or "kinematical" form $\dot{\chi}_i = f_i(\chi_i, V_i)$ with V_i a set of first integrals transforming as velocities. The Lorentz covariance requirements on f_i are worked out and illustrative examples are given, including a family of many-valued ones. A general meaning for integrals of $\ddot{\chi}_i = F_i$ being in involution is adduced, and general counterparts to some well-known theorems in Hamiltonian dynamics are obtained accordingly. A novel elementary proof of the zero-interaction theorem is appended. (auth)

34877 PARTICLE MOTION AND INTERACTION IN NONLINEAR FIELD THEORIES. Derrick, G. H.; Kay-Kong, Wan (Univ. of St. Andrews, Fife, Scotland). J. Math. Phys. (N. Y.), 9: 232-40(Feb. 1968).

A variational method is given for determining the motion and interaction of particles associated with fields governed by nonlinear differential equations. For field equations derived from Lagrangian densities of the type $g^{ik}(\partial\theta/\partial x^i)(\partial\theta/\partial x^k) + f(\theta)$, one obtains an attractive inverse-square law of force between like particles, provided $f(\theta)$ vanishes more rapidly than (constant) θ^4 for $\theta \rightarrow 0$. (auth)

34878 PHENOMENOLOGICAL APPROACH TO THE CORRESPONDENCE BETWEEN COMPOSITE SYSTEMS AND ELEMENTARY PARTICLES. Okabayashi, T. (Massachusetts Inst. of Tech., Cambridge). Nuovo Cim., 55A: 433-52(June 1, 1968).

The Goldberger-Treiman relation is re-examined, based on a model in which pion is composed of a nucleon pair. As to the self-interaction of nucleon field, only the invariance under the local gauge transformations in isospace and in chiral isospace is assumed. The relation can be reproduced to a fairly good approximation by a correspondence between a composite system and an elementary particle. The correspondence is phenomenological and not firmly established yet, but expected to shed some light on the correspondence problem because an important difference between a composite system and an elementary particle is revealed through the analysis. This is an attempt to understand field-theoretically the powerful working hypotheses, the current algebra and the hypothesis of partially conserved axial-vector current, although some phenomenological arguments are unavoidable in settling a correspondence relation between a composite system and an elementary particle. If some approximations or some special types of interactions are used, various kinds of correspondences between composite systems and elementary particles can be considered. Two examples of such correspondence methods are explained in the Appendices. (auth)

34879 ELEMENTARY PARTICLES AND THEIR CURRENTS. Bernstein, Jeremy. A Series of Books in Physics. San Francisco, W. H. Freeman and Co., 1968. 334p. $12.00.

The theory of elementary particles is treated in a unified way under the general theme of currents. The first chapter contains a brief review of the elements of field theory, especially of the free fields. In Chapter 2 the currents are introduced in a general way and the connection between current conservation and an invariance group is illustrated with the classical case of the group of invariances of a Lagrangian containing two degenerate scalar fields—the group SU(2). The fourth chapter deals with the electromagnetic field and the study of SU(2) as a "broken symmetry." Chapter 5 begins the study of electron-proton scattering; the experimental situation is treated in Chapter 6. A brief discussion of dispersion relations is given in Chapter 7. The next five chapters deal with the weak interactions of nonstrange particles. The remaining three chapters deal with the weak and electromagnetic interactions of strange particles. (L.B.S.)

34880 DISPERSIVE APPROACH TO THE STUDY OF INFINITE-MOMENTUM LIMITS AND EQUAL-TIME COMMUTATORS. Gervais, J.-L. (New York Univ., N. Y.). Phys. Rev., 169: 1365-7(May 25, 1968).

Recently, a difficulty was pointed out by the author in the proof of the so-called Fubini–Dashen–Gell-Mann sum rule given by the last two authors using an infinite-momentum limit. This difficulty, which is connected with the locality of the current, is solved here assuming certain regularity properties for the weight functions of the Jost-Lehmann-Dyson representation which one can write for the one-particle matrix elements of the commutators involving the current and/or its divergence. This makes it possible to express the equal-time commutator of the time components as a sum of ordinary covariant dispersion integrals where the dependence in the momentum is explicit, thus leading to a straightforward proof of the sum rule from the $p \to \infty$ limit. As is required by Lorentz invariance, this limit in fact turns out to be unnecessary, since the result is also obtained for finite p. Also, the same technique, applied to the equal-time commutator of the time and the space components of the current, shows that they must be of the form usually assumed in current-algebra calculations. (auth)

34881 MOTION OF A DIPOLE-QUADRUPOLE SYSTEM. Schiller, Ralph (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev., 169: 1282-7(May 25, 1968).

Niels Bohr showed that the magnetic moment of an electron cannot be determined by a Stern-Gerlach experiment. His argument is extended to other moments, and general conditions are stated as to when a moment determination is feasible by such an experiment. In addition, the expectation-value equations are given for a stationary, gyrating, nonrelativistic, spin-1 particle in arbitrary, but classical, external electromagnetic fields. For such a dipole-quadrupole system there is no distinction between the classical and quantal descriptions. Of interest is the fact that SU(3) is the invariance group of the motion. The theory is extended to the relativistic domain by Lorentz transformation. The group SU(3,1) appears as the invariance group of the internal motion. (auth)

34882 IS THERE A MASS QUANTUM? Aron, J. C. (Institut Henri Poincare, Paris). Progr. Theor. Phys. (Kyoto), 39: 1086-9 (Apr. 1968).

The possibility of a mass quantum number is examined first for the case of $I = 0$, $Y = 0$ particles. Mass formulas are then examined for the general case. (L.B.S.)

34883 UNITARITY OF DYNAMICAL PROPAGATORS OF PERTURBED KLEIN–GORDON EQUATIONS. Chadam, John M. (Indiana Univ., Bloomington). J. Math. Phys. (N. Y.), 9: 386-96(Mar. 1968).

After discussing the basic notions of quantizations as representations of the Weyl relations, a criterion is established for a symplectic transformation on a classical linear system to be unitarily implementable in the free (zero-interaction) representation. The result is applied to the temporal propagators of $\Box\phi = m^2\phi + K\phi$ to obtain a condition which is sufficient to ensure that they are unitarily implementable in the free representation of the quantized Klein-Gordon field of mass m. Necessary conditions are also obtained when K commutes with $m^2I - \Delta$. Several examples are discussed, the most interesting of which is that of a mass jump (i.e., $K = m'^2I$), where the results given are fairly complete. (auth)

34884 NUMBER OPERATORS FOR REPRESENTATIONS OF THE CANONICAL COMMUTATION RELATIONS. Chaiken, Jan M. (Cornell Univ., Ithaca, N. Y. Massachusetts Inst. of Tech., Cambridge). Commun. Math. Phys., 8: 164-84(1968).

A number operator for a representation of the canonical commutation relations is defined as a self-adjoint operator satisfying an exponentiated form of the equation $N a^* = a^*(N + I)$, where a^* is an arbitrary creation operator. When N exists it may be chosen to have spectrum $\{0,1,2,\ldots\}$ (in a direct sum of Fock representations) or $\{0,\pm1,\pm2,\ldots\}$ (otherwise). Examples are given of representations having number operators, and a necessary and sufficient condition is given for a direct-product representation to have a number operator. (auth)

34885 APPLICATION OF THE RIEMANN METHOD TO THE BETHE–SALPETER EQUATION. Honerkamp, J. (Univ., Hamburg). Commun. Math. Phys., 7: 234-60(1968).

The Bethe-Salpeter equation describing the interaction of two scalar particles via the exchange of a third scalar particle with mass $\mu \neq 0$ is in configuration space a hyperbolic partial differential equation of fourth order which will be studied with the help of the Riemann method. This method yields two Volterra equations the solutions of which are special solutions of the Bethe-Salpeter equation. The wave function is a superposition of the special solutions. For the coefficients one gets a system of two integral equations. The Fredholm determinant of the system is the generalization of the nonrelativistic Jost function. (auth)

34886 DERIVATION OF WEINBERG'S SECOND SUM RULE. Jackiw, R. (CERN, Geneva. Harvard Univ., Cambridge, Mass.). Phys. Lett., 27B: 96-8(June 10, 1968).

Weinberg's second sum rule is derived from assumptions about isospin structure, in a fashion closely analogous to the original derivation of the first sum rule. Models in which these isospin assumptions are satisfied are identified. (auth)

34887 MASS RENORMALIZATION AS AN AUTOMORPHISM OF THE ALGEBRA OF FIELD OPERATORS. Guenin, M. (Univ., Geneva); Velo, G. Helv. Phys. Acta, 41: 362-6(May 15, 1968).

In a model with only mass renormalization it is shown that the use of time translation operations not unitarily implementable enables one to overcome the difficulties connected with the Haag theorem. (auth)

34888 TAMAID–BACH THEORY OF SUBNUCLEAR PARTICLE STRUCTURE. Lewis, D. T. (Lab. of Government Chemist, London). Chem. Ind. (London), No. 23, 729-32(June 8, 1968).

An account is given of the development of a generic theory which would be applicable to all subnuclear particles, leptons, hadrons, etc. The theory involves the concept that all subnuclear particles are built up from two small neutral particles, a lighter particle called a "bach" and a heavier particle known as a "tamaid". If these entities are the ultimate particles of matter out of which all other mass-energy states are created, then the mass of $\underline{x}$ tamaids and $\underline{y}$ bachs would give the rest mass $\underline{M}$ of a subnuclear particle, $\underline{x}$ and $\underline{y}$ being integral numbers. See also Nature 216: 573, 784, and 5121 (1967). (UK)

34889 PROKHOZHDENIE IZLUCHENIYA CHEREZ VESHCHESTVO. (Radiation Penetration Through Matter). Alekseev, A. I. (ed.). Moscow, Atomizdat, 1968. 200p.

Fourteen articles are given on the theory of high-energy photon scattering on electrons, interactions of magnetic waves in plasma, radiation in confined media, and multiple elastic scattering of particles in matter. Cherenkov radiation and bremsstrahlung in abnormal dispersion region, electromagnetic processes in a quantum generator, the temperature influence on helium–neon laser, quantum theory methods for describing properties of atomic nuclei and spin structure of the amplitude of vector meson generation during high-energy pion interactions with nucleons are discussed. (R.V.J.)

34890 ON LOCAL ONE-PARTICLE APPROXIMATIONS AND LOCALLY CONSERVED CURRENTS. II. Voelkel, Uta; Voelkel, Adolf H. (Univ. of Pittsburgh). Contract AT(30-1)-3829. Commun. Math. Phys., 7: 261-70(1968).

As an extension of earlier work a local one-particle approximation is constructed for matrix elements of two four-vector currents. The approximation is constructed to fulfill a divergence condition which makes sure that current conservation is not destroyed by the approximation. (auth)

34891 THE THEORY OF THE CONSOLIDATION OF EQUATIONS OF THE BARGMAN–WIGNER TYPE. Bas'yuni, A. Kh. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 1, 85-?(Jan.–8 Feb. 1968). (In Russian).

The Bargman–Wigner equations, as is known, are impossible to obtain from simple Lagrangians. Lagrange functions were constructed without introduction of supplementary field equations, decomposing into three equation systems. The latter corresponds with the spins $^3/_2$, $^1/_2$, $^1/_2$. In the same way Lagrange functions were constructed leading to consolidation equations, decomposing into equations only for spin $^3/_2$, $^1/_2$ in agreement with the decomposition of $\widetilde{U}$. On the basis of the Pais equation, equations of the Bargman-Wigner type were obtained with consideration of isospin. (tr-auth)

34892 IMPROVED METHOD FOR THE ESTIMATION OF PRIMARY ENERGY. Bhowmik, B.; Singh, S. (Univ. of Delhi). Nuovo Cim., 55B: 575-7(June 11, 1968).

A method for the estimation of primary energy which does not use the assumption of symmetry of showers in the cm system and requires a knowledge of the rest mass, the angle of emission in the L system, and the transverse momentum of the created shower particles is given. This method is verified using experimental data on $p + N$ and $\pi^- + N$ interactions at momenta of 22.8 and 17.2 GeV/c respectively. The values of the Lorentz factor are found for these interactions. (J.F.P.)

34893 FERMI-ODD INTERACTIONS. Likhachev, V. N. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 7: 913-25 (Apr. 1968). (In Russian).

A formal solution of the Cauchy problem with the variable operator different from that by Dyson is proposed which makes it possible to apply the Wick theorem to the Fermi-odd interaction. By means of the method proposed, several model problems are solved. The class of problems which can be considered as Fermi-odd and to which the formalism proposed is applicable, is presented. (auth)

34894 NONRELATIVISTIC PERTURBATION THEORY AND THE Z = 0 CONDITIONS FOR COMPOSITE PARTICLES. Braun, M. A. (Leningrad State Univ.). Yadern. Fiz., 7: 926-33(Apr. 1968). (In Russian).

It is shown that describing a composite particle in the nonrelativistic theory as an independent field one is able to expand substantially the domain of applicability of the perturbation theory. Parameters of the composite particle are determined by the conditions $Z_1 = Z = 0$. (auth)

34895 DISPERSION SUM RULES FOR FORM FACTORS. Khalfin, L. A. (Inst. of Mathematics, Leningrad). Yadern. Fiz., 7: 876-8(Apr. 1968). (In Russian).

Sum rules for form factors are derived, which, in particular, relate the form factor, the cross section in the annihilation channel, and the root-mean-square radius of an elementary particle. The sum rules are obtained that use most totally the information on the form factor behavior. (auth)

Electromagnetic

Refer also to abstracts 34825, 34940, 35118, 35119, and 35154.

34896 (DESY-68/7) THEORY OF DOUBLE PION PHOTOPRODUCTION AT LOW ENERGIES. Lueke, D.; Scheunert, M.; Stichel, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr. 1968. 22p. Dep.

The process $\gamma + p \rightarrow \Delta^{2+}(1236) + \pi^-$ at low energies is discussed by taking into account the gauge invariant extended OPE-contribution and a small admixture of isobaric contributions. Reasonable agreement with recent experimental data from the Aachen-Berlin-Bonn-Hamburg-Heidelberg-München collaboration is obtained. (auth)

34897 (NP-17476) INTERFERENCE OF ρ^0 AND ω STATES IN $e^+e^- \rightarrow \pi^0\gamma, \eta\gamma$. Note No. 153. Benfatto, G. (Rome Univ. (Italy). Istituto di Fisica). Jan. 24, 1968. 10p. Dep.

It is assumed that the $\pi^0\gamma$ and $\eta\gamma$ states produced in $e^+ + e^-$ annihilation interactions, with a total cm energy 2E between 700 and 800 MeV, are dominated by the ρ^0 and ω resonances. The interference of these resonances is studied by means of the quark model. The calculated cross section for this reaction is shown. (J.F.P.)

34898 (NP-17489) FINITE ENERGY SUM RULES FOR PION PHOTOPRODUCTION AND THE ω-REGGE POLE RESIDUE FUNCTIONS. Note No. 150. Di Vecchia, P.; Drago, F.; Paciello, M. L. (Rome Univ. (Italy). Istituto di Fisica). Jan. 16, 1968. 27p. Dep.

The behavior of the ω residue functions in pion photoproduction is studied. It is shown that they have no zeros at $t \simeq -0.15$ $(GeV/c)^2$: this is in striking contradiction with the usual explanation of the crossover phenomena. The behavior of the ω trajectory near the wrong signature nonsense point $\alpha = 0$ was investigated. The usual theory of the dip seems to work well and suggests that unlike the ρ, the ω trajectory is nonsense choosing. (auth)

34899 SEMICLASSICAL AND QUANTUM DESCRIPTIONS. Misra, S. P. (Regional Engineering Coll., Orissa, India); Shankara, T. S. J. Math. Phys. (N. Y.), 9: 299-304(Feb. 1968).

In the semiclassical descriptions, it is usual to describe a quantum-mechanical system in a classical language with a correspondence between classical functions and operators of quantum mechanics and with a real, but not necessarily positive, probability density function in phase space corresponding to a particular quantum-mechanical state. The general forms of such semiclassical descriptions are discussed. The conditions for the two descriptions to be equivalent are also examined. (auth)

34900 FURTHER EXACT SOLUTIONS OF THE DIRAC EQUATION. Stanciu, George N. (Los Alamos Scientific Lab., N. Mex.). J. Math. Phys. (N. Y.), 8: 2043-7(Oct. 1967).

The four exactly solvable problems for the Dirac equation previously found are discussed in detail. The presentation is mainly within the two-component relativistic description of a spin $\frac{1}{2}$ particle. Both bound state and scattering solutions are considered. (auth)

34901 ASYMPTOTIC THEORY OF CHERENKOV RADIATION IN INHOMOGENEOUS MEDIA. Handelsman, R. A.; Lewis, R. M. (New York Univ., N. Y.). J. Math. Phys. (N. Y.), 9: 260-9(Feb. 1968).

The problem of Čerenkov radiation in infinite inhomogeneous media is considered. The mathematical description of this phenomenon is given by the integro-differential system of equations for the electromagnetic field in a dispersive medium. The leading term of the asymptotic expansion of the electromagnetic field is obtained by applying an expansion procedure called the "ray method". In this method all the functions that appear in the expansion satisfy ordinary differential equations along certain space-time curves called rays. The source which gives rise to the radiation is taken to be quite general. In fact, it is shown that any multipole moving along an arbitrary trajectory is a special case of the general source considered. From the expansion of the fields an expression for the total energy of the radiation is determined. Then, as an example, the case of plane-stratified media is treated in detail. (auth)

34902 COHERENT SOFT-PHOTON STATES AND INFRARED DIVERGENCES. I. CLASSICAL CURRENTS. Kibble, T. W. B. (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 9: 315-24(Feb. 1968).

As a first step toward a treatment of soft-photon processes which is free of infrared divergences and avoids the necessity of introducing a fictitious photon mass, the specification of asymptotic photon states being to non-Fock representations is discussed. As in the work of Chung, a basis consisting of generalized coherent states is used, but in contrast to his work, these states are rigorously defined in terms of von Neumann's infinite tensor product. It is shown that the states must be given an additional label which serves to distinguish various "weakly equivalent" vectors, and which corresponds formally to an infinite phase factor. A nonseparable Hilbert space $\mathcal{H}_{IR}$ is defined (as a subspace of the infinite tensor-product space) which may be regarded as the space of all possible asymptotic photon states. The interaction of the electromagnetic field with a prescribed classical current distribution is discussed, and it is shown that a unitary S operator, all of whose matrix elements are finite, may be denfied on $\mathcal{H}_{IR}$. (auth)

34903 POSSIBLE MEASUREMENT OF THE NUCLEON AXIAL-VECTOR FORM FACTOR IN TWO-PION ELECTROPRODUCTION EXPERIMENTS. Adler, Stephen L. (Inst. for Advanced Study, Princeton, N. J.); Weisberger, William I. Phys. Rev., 169: 1392-7(May 25, 1968).

Current-algebra techniques and the hypothesis of partially conserved axial-vector current are used to derive a low-energy theorem for the reaction $e + N \rightarrow e + N + \pi + \pi(\text{soft})$. Particular attention is paid to satisfying the requirements of gauge covariance. Except for recoil corrections, the resulting matrix element is proportional to the nucleon axial-vector form factors. It is suggested that this electromagnetic process may be used to measure $g_A(k^2)$. (auth)

34904 POLARIZATION EFFECTS ON PHOTOPRODUCTION OF SYMMETRIC LEPTON PAIRS. Shieh, Shuang-yuan (Lehigh Univ., Bethlehem, Pa.). Phys. Rev., 169: 1390-1(May 25, 1968).

Both Bethe-Heitler (BH) and Compton diagrams for photoproduction of symmetric lepton pairs are calculated with polarization correlation of all particles involved taken into account and without omission of mass terms. It is found that for photoproduction of lepton pairs with the same helicity, either the BH or the Compton amplitude vanishes, and there is no interference term at all between BH and Compton processes; while for photoproduction of lepton pairs with opposite helicities the interference term vanishes when the summation over helicities is taken. The results are also applied to an inquiry into the helicities of muon pairs from photoproduction. (auth)

34905 NEW LOW-ENERGY THEOREMS FOR PION AND NUCLEON COMPTON SCATTERING. Yamamoto, Kunio (Syracuse Univ., N. Y.). Contract AT(30-1)-3399. Phys. Rev., 169: 1353-6(May 25, 1968). (SU-1206-141).

Low-energy theorems for pion and nucleon Compton processes which give terms to all orders in the laboratory photon energy of an appropriate set of invariant functions are derived. So long as the only additional constraint is current conservation, there exist no other low-energy theorems for these processes. The method of derivation is sufficiently general that it can be applied to other photon processes as well. (auth)

34906 CALCULATION OF THE $\Delta(1236)$ RESONANT PARTIAL AMPLITUDES IN PION PHOTOPRODUCTION. Engels, J. (Technische Hochschule, Karlsruhe, Ger.); Schmidt, W. Phys. Rev., 169: 1296-1307(May 25, 1968).

Using an N/D-type ansatz, a modified dispersion relation for the partial-wave amplitudes is derived. The equations, if applied to the first resonance in pion photoproduction, allow a fairly complete incorporation of our phenomenological knowledge of the pion-nucleon final state together with a systematic treatment and estimate of the terms to be neglected in practice. Various possibilities of including unknown or uncertain high-energy contributions are discussed and applied. Explicit results for the multipoles E_{1+}^{S}, M_{1+}^{S} are presented. (auth)

34907 BACKWARD COMPTON SCATTERING SUM RULE AND THE $\pi^0 \rightarrow 2\gamma, \eta^0 \rightarrow 2\gamma$ DECAY RATES. Choudhury, S. Rai (Princeton Univ., N. J.); Rajaraman, R. Phys. Rev., 169: 1218-22 (May 25, 1968).

The superconvergence of certain Compton scattering (s-channel) helicity amplitudes for fixed s and large t, is used to derive a sum rule for t- and u-channel processes. The u-channel ($\gamma N \rightarrow \gamma N$) contribution contains the well-known nucleon pole terms and the continuum, which is replaced by just the π-N intermediate states; photoproduction data are then included. The t-channel ($\gamma\gamma \rightarrow N\bar{N}$) contribution consists of the π, η poles and the continuum. A suitable combination of superconvergent amplitudes is chosen such that the effects of 0^+, 2^+, and 1^+ resonances in the t channel are eliminated. Assuming that this takes care of most of the t-channel continuum, a sum rule is obtained for the $\pi^0 \rightarrow 2\gamma$ and $\eta^0 \rightarrow 2\gamma$ widths, or alternatively, by using the experimental widths, the consistency of the superconvergence in question can be checked. A brief comparison is made with related work by Goldberger and Abarbanel, and by Pagels. (auth)

34908 MULTIPION PHOTOPRODUCTION AT ENERGIES UP TO 6 BeV. Phys. Rev., 169: 1081-9(May 25, 1968).

The photoproduction of multipion (≥ 3) final states was studied in a hydrogen bubble chamber exposed to a 4.8 to 6.0-BeV bremsstrahlung photon beam. It is found, in most channels, that the reactions are dominated by the production of resonances. In particular, in the three-prong events the photoproduction of η^0 mesons and associated production of $N^{*++}(1238)$ and ρ^- are discussed. In the five- and six-body final states the production of $N^{*++}(1238)$ and ω^0 mesons is seen. A slight enhancement of the $p\pi^+\pi^+$ and $n\pi^-\pi^-$ system observed at about 1560 MeV is also discussed. (auth)

34909 THRESHOLD ELECTRODISINTEGRATION OF THE DEUTERON. Adler, Ronald J. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., 169: 1192-1202(May 25, 1968).

Threshold electrodisintegration of the deuteron caused by scattering of electrons is studied at angles near 180°. The cross section for this reaction is calculated, using nonrelativistic deuteron wave functions. The deuteron D state is included in the calculation, as well as all of the relevant meson exchange currents. Disagreement of the calculated results with recent electron scattering experiments indicates that a basic difficulty exists in our present understanding of the deuteron wave function and the core radius of the nucleon. A crude Fourier transform is then performed on the experimental transition form factor to yield the configuration-space overlap charge density. The resultant overlap charge density indicates that a softer nucleon core is needed than is presently popular. (auth)

34910 APPROXIMATIONS FOR CALCULATING RADIATIVE CORRECTIONS. Huld, B. (Harvard Univ., Cambridge, Mass.). Contract AT(30-1)-2752. Phys. Rev., 169: 1115-20(May 25, 1968).

A new approximation for calculating the radiative correction due to the emission of real photons is discussed. This approximation is an improvement on the previously used approximations, namely, the soft-photon and peaking approximations, both of which are also discussed. (auth)

34911 INELASTIC ELECTRON SCATTERING IN THE SYMMETRIC QUARK MODEL. Thornber, N. S. (Stanford Univ., Calif.). Phys. Rev., 169: 1096-1104(May 25, 1968).

The nonrelativistic symmetric quark model is used to compute form factors for the process $e + p \rightarrow e + N^*$, where N^* is one of nine nucleon resonances. A harmonic-oscillator potential is assumed and Gaussian-type form factors are obtained. Center-of-mass motion is separated out, and $1/M_q^2$ corrections are discussed. Plots are made of the form factors and transition probabilities; the theoretical numbers generally agree with the existing experiment when $q^2 < 1$, but the predicted magnitudes are too small for $q^2 > 1$. (auth)

34912 ρ AND ω LEPTONIC DECAYS IN PHOTOPRODUCTION. Davier, M. (Stanford Univ., Calif.). Phys. Lett., 27B; 27-9 (May 1968). (SLAC-PUB-397).

The leptonic decays of photoproduced vector mesons $\rho \rightarrow l^+l^-$ and $\omega \rightarrow l^+l^-$ are examined in detail, and the possible consequences for the electromagnetic properties of vector mesons are investigated within the framework of the vector dominance model. (L.B.S.)

34913 PREDICTION OF THE ISOVECTOR NUCLEON FORM FACTOR $F_1^V(t)$. Cordes, J. G.; O'Donnell, P. J. (Univ. of Toronto). Phys. Rev. Lett., 20: 1462-5(June 17, 1968).

Predictions are obtained for the isovector nucleon form factor $F_1^V(t)$ by extending the hypotheses of ρ dominance of the isovector current and universality to include a second isovector resonance ρ' in a dispersion relation for $F_1^V(t)$ and requiring that $F_1^V(t) \sim t^{-2}$. The effect of this meson on various current-algebra and vector-dominance sum rules is investigated. (L.B.S.)

34914 ALGEBRA OF CURRENT AND THE NONRELATIVISTIC QUARK MODEL. Niizeki, Komajiro (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 1025-37(Apr. 1968).

Many relations among electromagnetic quantities of hadrons have been derived by using the algebra of current. However, most of the resulted equations coincide with those resulting from the nonrelativistic quark model. The reason for these coincidences is clarified. The main points are i) the assumption of existence of quark or quark field (in both theories), where quark is fundamental triplet of SU(3), ii) closure assumption in the algebra of current, iii) a particular circumstance that the total orbital angular momentum of the state under consideration is zero in the nonrelativistic quark model. (auth)

34915 WEAK AXIAL MEAN SQUARE RADIUS OF THE NUCLEON FROM PHOTOPRODUCTION SUM RULES. Ghika, G.; Radescu, E.; Visinescu, M. (Inst. for Atomic Physics, Bucharest). Progr. Theor. Phys. (Kyoto), 39: 1085-6(Apr. 1968).

A relation between the weak and electromagnetic nucleon form factor was previously obtained in a dispersion evaluation of a current algebra photoproduction sum rule, using the static approximation. The possibility of bringing the method in accord with experiment by incorporating the effect of the N^* is examined. (L.B.S.)

34916 VECTOR-DOMINANCE MODEL COMPARISON OF π^+ PHOTOPRODUCTION WITH ρ^0 PRODUCTION BY PIONS. Diebold, R. (Stanford Linear Accelerator Center, Calif.); Poirier, J. A. Phys. Rev. Lett., 20: 1532-5(June 24, 1968).

A comparison of the reactions $\gamma p \rightarrow \pi^+ n$ and $\pi^- p \rightarrow \rho^0 n$ at 4 and 8 GeV/c was made using the vector-dominance model. Although the ρ^0 data are insufficient to show the very narrow forward peak observed in the photoproduction data, agreement is obtained to within errors for $|t| \lesssim 0.1$ (GeV/c)^2. Taking interference effects into account, this agreement can be extended to $|t| \approx 1.5$ (GeV/c)^2 at 4 GeV/c, but only to 0.3 (GeV/c)^2 at 8 GeV/c. (auth)

34917 ANALYTIC PROPERTIES OF CERTAIN RADIAL MATRIX ELEMENTS. Almstroem, H.; Olsson, P. (Royal Inst. of Tech., Stockholm). J. Math. Phys. (N. Y.), 8: 2013-21(Oct. 1967).

The analytic properties of the Laplace transform of products of two confluent hypergeometric functions as a function of certain parameters are investigated. The radial matrix element of multipole type that contain Coulomb–Dirac wavefunctions or special cases thereof are considered. These are investigated as functions of the momenta p of the particles. Branch cuts and the behavior along the branch cuts in the complex p plane are given. The formulas presented permit accurate calculation of the matrix elements also, when the parameters have values arbitrarily close to singular points. The prime concern, however, is to facilitate second- and higher-order perturbation calculations. (auth)

34918 CONCERNING THE TRANSFORMATION OF PHOTON PAIRS INTO HADRONS AT HIGH ENERGIES. Ispiryan, K. A.; Matinyan, S. G. JETP Lett. (USSR) (Engl. Transl.), 7: 178-80 (Apr. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 232-4(Apr. 5, 1968).

The $\gamma\gamma$ interaction at high energies is considered on the basis of the vector dominance model. The differential cross section for $\gamma + \gamma \rightarrow \rho^0 + \rho^0$ interactions is found to be 0.16 k^2 μb/sr, where k in the GeV range, and $\sigma_{\gamma\gamma}^t \approx 0.013$ μb. It is also ascertained whether the results obtained change the situation concerning the absorption of photons of very high energy in intergalactic space. It is found that the studied mechanism does not essentially change the question of the absorption of photons in the universe for reasonable values of the γ quantum energies. (J.F.P.)

34919 A CONTINUITY EQUATION FOR THE SCALAR RIEMANN CURVATURE OF THE SPACE-TIME FURNISHING THE NUMBERS μ/m AND α. Charon, Jean E. Compt. Rend., Ser. A and B, 266: 750-3(Apr. 1, 1968). (In French).

A continuity equation is proposed for the scalar Reimann curvature R of space-time. The ratio $\mu/m = 1836$ of the self masses of the proton and the electron were deduced from these solutions to almost 1/10,000 and the ratio $g_f/g_e = 276$ of the strong and electromagnetic interactions was deduced (mass of the charged π meson to almost 1/100). The principle of the calculation of $\alpha = e^2/\hbar c = 1/137$ was furnished. (tr-auth)

34920 ELECTROMAGNETIC MASS DIFFERENCES AND COMPOSITE PARTICLES. Ciccariello, S. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua); Tonin, M.; Sartori, G. Nuovo Cim., 55A: 847-9(June 21, 1968).

It is pointed out that in a recently developed field-theoretic Lagrangian model the electromagnetic mass differences turn out to be infinite except for zero-mass particles. It is suggested that this difficulty could be connected to the fact that in the algebra of fields the vector and axial-vector mesons are treated as elementary particles, whereas it could disappear if these particles were treated as composite ones. Some indications in this direction are given. (L.B.S.)

34921 FINITE-ENERGY SUM RULES FOR PION PHOTOPRODUCTION AND THE ω REGGE POLE RESIDUE FUNCTIONS. Di Vecchia, P. (CNEN, Rome); Drago, F.; Paciello, M. L. Nuovo Cim., 55A: 809-26(June 21, 1968).

The behavior of the ω residue functions in pion photoproduction was studied. It is shown that they have no zeros at $t \approx -0.15$ (GeV/c)^2; this is in striking contradiction with the usual explanation of the cross-over phenomena. The behavior of the ω trajectory near the wrong signature nonsense point $\alpha = 0$ was also investigated. The usual theory of the dip seems to work well and suggests that unlike the ρ, the ω trajectory is nonsense-choosing. (auth)

34922 CONSPIRACY AND FACTORIZATION IN VECTOR-MESON PHOTOPRODUCTION. Di Vecchia, P. (CNEN, Rome); Drago, F.; Paciello, M. L. Nuovo Cim., 55A: 724-37(June 21, 1968).

The conspiracy relations are deduced for reactions of the type $\gamma + \mathcal{N} \to V + \mathcal{N}$. The residua factorization that, in principle, could give some information about conspiracy or evasion is then studied. It is shown that, in this case, the group theoretical results about the conspiracy or the evasion of the involved Regge trajectories can be deduced from crossing symmetry, analyticity, factorization and some very general experimental information. (auth)

34923 INTENSITY-DEPENDENT GAIN IN MOMENTUM OF ELECTRONS IN ELECTROMAGNETIC WAVES. Prakash, H.; Chandra, N. (Univ. of Allahabad, India). Nuovo Cim., 55B: 608-10(June 11, 1968).

It is shown semiclassically using a wave packet of Volkov solutions of the Klein–Gordon equation that there is an intensity-dependent gain in momentum when the electron interacts with electromagnetic waves. The Klein–Gordon equation for the electron is used because the spin has nothing to do with the intensity-dependent gain in momentum. A completely quantistic treatment is not attempted. (J.F.P.)

34924 USE OF VOLKOV SOLUTIONS OF ELECTRON WAVE EQUATIONS IN ELECTROMAGNETIC WAVE FOR SCATTERING PROBLEMS. Prakash, H.; Chandra, N. (Univ. of Allahabad, India). Nuovo Cim., 55B: 404-12(June 11, 1968).

It is shown that although the Volkov solution of the Klein-Gordon equation of the electron in an electromagnetic wave cannot be used for scattering problems, wave packets of Volkov solutions can still be used. It is also shown that the Von Roos solution of the Klein-Gordon equation of the electron in an electromagnetic wave is the same as the perturbation expansion of the Volkov solution of this equation in powers of the vector potential of the electromagnetic wave when the factor responsible for adiabatic switching is taken as unity. (auth)

34925 SUM RULES FOR THE COMPTON EFFECT. Shekhter, V. M. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 7: 849-69(Apr. 1968). (In Russian).

Feynman diagrams analysis allows one to obtain the gage-noninvariant part of the Compton scattering amplitude, that arises when the isovector and the isoscalar parts of the electromagnetic interaction are treated separately. One can determine also the part of the transverse amplitude in the Breit coordinate system, that is singular in the $\nu \to 0$ limit at fixed momentum transfer. A set of sum rules for the invariants of the amplitude may be found assuming that in the dispersion relations for these invariants off-integral terms are absent and the integrals converge. However most of the dispersion integrals seem to be divergent. One of the exceptions is a new sum rule for the isovector magnetic radius of the nucleon. Besides, the absence of the gage invariance gives rise, as a rule, to off-integral terms in the dispersion relations, independently of the convergence of the integrals. (auth)

34926 VECTOR-MESON ELECTROPRODUCTION IN NUCLEAR COULOMB FIELD. Nagorskaya, I. A.; Ter-Isaakyan, N. L. Yadern. Fiz., 7: 840-2(Apr. 1968). (In Russian).

The cross section of the low-energy W-meson electroproduction in the nuclear Coulomb field is obtained. The total cross section is by two orders of magnitude lower than that given previously. (auth)

34927 SUM RULE FOR THE PION ELECTROMAGNETIC FORM FACTOR. Nicolo, F. (Univ., Rome); Rossi, G. C. Nuovo Cim., 56A: 207-17(July 1, 1968).

A method for obtaining a sum rule for the pion electromagnetic form factor is proposed. Numerical evaluations give $F_\pi(k^2) \approx F_1^V(k^2)$. Some results about residues of the pion trajectory at $t = m_\pi^2$ for every k^2 are also obtained in the evasive and in the conspiratorial case. (auth)

34928 DOUBLE CONSPIRACY IN π^+ PHOTOPRODUCTION. Borgese, A. (Istituto Nazionale di Fisica Nucleare, Florence); Colocci, M. Nuovo Cim., 56A: 345-8(July 1, 1968).

It is pointed out that the addition of conspiring B-exchange to the π conspiracy can offer a possible solution to the energy dependence of the forward peak in π^+ photoproduction cross sections. (L.B.S.)

34929 SPIN ONE AND THE BARGMANN–WIGNER EQUATIONS. Portner, G.; Rafanelli, K. (Queens Coll., Flushing, N. Y.). Nuovo Cim., 56A: 218-25(July 1, 1968).

Some dynamical properties of the bound two-quark system which obeys the Kemmer equation are presented. The second-order wave equation for the free spin-one particle exhibits a strong coupling term between the two constituent spin–one-half states. For the particle minimally coupled to external electromagnetic fields the two linear equations (generalized Bargmann-Wigner equations) implied by the Kemmer equation are derived. The second-order equation for the spin-one particle now exhibits both strong and electromagnetic coupling between the spin–one-half states. The latter is then analyzed in terms of normal modes. (auth)

34930 GENERALIZED UNITARITY AND LOW-ENERGY THEOREMS. Horn, D. (Tel Aviv Univ., Israel. CERN, Geneva); Jacob, M. Nuovo Cim., 56A: 83-91(July 1, 1968).

The question of how and when one has to include low-energy theorems within the framework of S-matrix theory together with generalized unitarity is discussed. It is shown by means of explicit examples how the low-energy theorems emerge when a photon is involved and why they are not implied if the photon is replaced by a massive vector meson. (auth)

34931 SUPERCONVERGENCE AND CURRENT ALGEBRA FOR A SPIN-½ TARGET. II. Boiti, M.; Pempinelli, F.; Zandron, O. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cim., 56A: 33-52(July 1, 1968).

The analytic properties in the Khuri plane of the invariant amplitudes that define a scattering process of a spin-1 "current" on a spin-½ target are studied. Some current algebra and superconvergence identities are obtained. The last ones are derived in two different ways. Finally the use of the formalism developed throughout allows the well-known low-energy theorem for the Compton scattering to be rederived. (auth)

Weak

Refer also to abstracts 35011, 35084, and 35119.

34932 (JINR–P1-3788) PROTSESS REGENERATSII $K_L^0 \to K_S^0$ PRI BOL'SHIKH ENERGIYAKH. (Regeneration Process $K_L^0 \to K_S^0$ at High Energies). Okonov, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1968. 12p. (In Russian). Dep.

It is suggested to use $K_L^0 - K_S^0$ regeneration at high energies for investigation of the asymptotic behavior of imaginary and real parts of KN- and $\overline{K}$N-scattering amplitudes, for the search of "strange" baryon resonances and for the determination of electromagnetic K^0-meson dimensions. (auth)

34933 VECTOR-MESON DOMINANCE AND NONLEPTONIC HYPERON DECAYS. Kumar, A. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cim., 55A: 568-71(June 1, 1968).

The equivalence of the vector-meson dominance-ansatz with current algebra and SU_6 is demonstrated for the case of nonleptonic hyperon decays. (auth)

34934 THE VECTOR CURRENT IN RADIATIVE WEAK PROCESSES. Kummer, W.; Majerotto, W. (Institut fuer Hochenergiephysik, Vienna). Nuovo Cim., 55A: 558-67(June 1, 1968).

In the presence of external photons the matrix elements of the vector current and of its divergence can be of the same order. Therefore the conserved vector-current hypothesis (CVC) cannot hold generally. As an illustration the deviation from the CVC result is calculated using a sum rule which is obtained by the standard Fubini method for the weak vector current in the decay $\pi \rightarrow \gamma + e + \nu$. For this reaction the naive CVC result turns out to be true accidentally for currents of first kind, because of a G-parity argument. However, after a trivial modification our sum rule applies as well for $K \rightarrow \gamma + e + \nu$, where in a certain model of exact SU_3 important modifications are observed. (auth)

34935 K_{l3} DECAY FORM FACTORS AND THE CURRENT ALGEBRA. Matsuda, S.; Oneda, S. (Univ. of Maryland, College Park). Phys. Rev., 169: 1172-5(May 25, 1968).

The K_{l3} decay form factors are studied by using a current algebra. Compared with the previous approach, the following points are new. The pion partially conserved axial-vector current (PCAC) hypothesis is used instead of kaon PCAC. A smaller off-mass-shell extrapolation $-q_\mu^2 = m_\pi^2 \rightarrow 0$ is used instead of the usual soft-pion extrapolation $q_\mu \rightarrow 0$. A dispersion technique is applied to a direct calculation of the form factors $F_+(s)$ and $F_-(s)$, and the current algebra is utilized to fix the absolute scale as well as the energy dependence with an approximation for vector currents proposed before. For the $F_+(s)$, the K*-meson contribution gives a result consistent with the Ademollo-Gatto theorem at $s = 0$. For the $F_-(s)$, both the K* and the $I = \frac{1}{2}$, 0^+ meson, κ, contribute. The expression for the $F_-(s)$ depends only on the mass of the κ meson (not on its width) and satisfies explicitly the requirement that $F_-(s) \rightarrow 0$ in the SU(3) limit. The parameter ξ is given by $\xi = F_-(0)/F_+(0) = -0.026 - (0.061\ \text{GeV}^2)/m_\kappa^2$. Therefore, a small negative value is predicted for ξ. The method gives information on $F_+(s)$ and $F_-(s)$ for all the physical values of s, including the most important region around $s = 0$, whereas the soft-pion approach gives information only at the rather unphysical point $s = m_K^2$. However, at this very point, the results on $F_+(m_K^2) + F_-(m_K^2)$ agree with that of the soft-pion approach independently of the parameter m_κ. Therefore, the results include the soft-pion result at $s = m_K^2$ and seem to give a consistent description of the K_{l3} decay form factors. (auth)

34936 QUARK MODELS, CURRENT ALGEBRAS, AND RADIATIVE CORRECTIONS TO BETA DECAY. Callan, Curtis G. Jr. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 169: 1175-8 (May 25, 1968).

Radiative corrections to semileptomic decays are studied. Special commutation relations between the weak and electromagnetic currents reduce the question of finiteness of $i \rightarrow f + e^- + \bar{\nu}$ to that of the finiteness of $\langle f|J_\mu^W|i\rangle/\sqrt{Z_2^q}$. In a quark model with interactions properly chosen, standard renormalization theory is then used to prove that these quantities, hence the order-α radiative corrections to any β decay, are finite. It is concluded that commutators are not enough and that some small amount of dynamics is needed to remove divergent radiative corrections. (auth)

34937 DECUPLET POLES IN THE TADPOLE MODEL FOR NONLEPTONIC HYPERON DECAYS. Loebbaka, D. S. (Univ. of Maryland, College Park. Univ. of Notre Dame, Ind.). Phys. Rev., 169: 1121-4(May 25, 1968).

Using a previously discussed dynamical model, it is shown that the baryon octet and decuplet poles alone lead to a simple explanation of the observed parity-violating nonleptonic hyperon decay amplitudes, essentially without involving any unknown parameters, provided that the strong interactions are SU(3)-invariant. (auth)

34938 K^+ THREE-BODY LEPTONIC DECAY MODES. Eisler, Fred R.; Fung, Sun Y.; Marateck, Samuel L.; Meyer, Stuart L.; Plano, Richard J. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., 169: 1090-5(May 25, 1968).

The $K_{\mu 3}^+ \rightarrow \pi^0 + \mu^+ + \nu$ and $K_{e3}^+ \rightarrow \pi^0 + e^+ + \nu$ decay-mode Dalitz-plot distributions were studied for lepton momenta below 120 MeV/c, using an exposure of the Brookhaven 30-in. propane bubble chamber to a stopping beam of K^+ mesons. The vector momentum of the π^0 was obtained with a typical error of 5% by considering only those events in which both γ rays from the π^0 decay converted to electron-positron pairs. Both decay modes are consistent with a pure vector interaction. 78 $K_{\mu 3}$ events yield the results, assuming ξ to be independent of momentum transfer: $\text{Re}\xi = -0.5 \pm 0.9$, $|\text{Im}\xi| = 0.0^{+0.3}_{-0.0}$, and a discrimination of 150 : 1 against a second value of $\text{Re}\xi = -5.3 \pm 0.7$. There were 90 K_{e3} events consistent with a constant form factor f^+, giving $\lambda_+ = -0.02^{+0.08}_{-0.12}$. (auth)

34939 SIMPLE QUARK MODEL FOR NONLEPTONIC HYPERON DECAYS. Miyake, Shogo; Toda, Azuma (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 1081-2(Apr. 1968).

An attempt is made to clarify the ambiguities in the treatment of the interaction Hamiltonians in the quark level, which have led to different results for p-wave amplitudes for nonleptonic hyperon decays. (L.B.S.)

34940 SOME RADIATIVE MESON DECAY PROCESSES IN CURRENT ALGEBRA. Riazuddin; Sarker, A. Q. (Univ. of Islamabad, Rawalpindi, Pakistan). Phys. Rev. Lett., 20: 1455-8(June 17, 1968).

The two-body radiative decays of nonstrange vector and pseudoscalar mesons are calculated by using the technique of current algebra, partial conservation of axial-vector current, and hard pion and eta. The predictions agree quite well with the available experimental results. (auth)

34941 LEPTONIC DECAYS OF BARYONS. Bender, I.; Linke, V.; Rothe, H. J. (Univ., Heidelberg). Z. Phys., 212: 190-212(1968).

Formulas are obtained for the differential decay rate, lepton spectrum, and partial lifetime for the leptonic decays of baryons, which cover effects down to the order of one percent. A weak, linear q^2-dependence of the form factors is included, which should be a sufficiently good approximation in the physical q^2-range allowed in the decays. The one percent discrepancy arises as a consequence of the above-mentioned approximation to the form factors, whose value and slope at $q^2 = 0$ are left open in the formulas; SU(3) symmetry, CVC, and PCAC yield an estimate for these parameters. (auth)

34942 OCTET DOMINANCE IN NONLEPTONIC DECAYS. Mathur, V. S.; Olesen, P. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 20: 1527-8(June 24, 1968).

A simple feature of the standard weak interaction theory is pointed out, which sheds new light on the $\Delta I = \frac{1}{2}$ rule (and octet dominance) in the nonleptonic decays. An expression is obtained for the dominant contribution to the nonleptonic amplitudes in terms of the matrix elements of an octet σ, considering the vector-boson theory. Several conclusions drawn from this expression are outlined. (L.B.S.)

34943 ABSORPTION OF $\bar{\nu}_\mu$ BY PROTONS. Zhang, Yang-zhong; Qing, Chen-duan (Peking Univ.). Chin. J. Phys. (Peking) (Engl. Trans.), 22: 638-9(Jan. 1968).

Translated from Wu Li Hsueh Pao, 22: 842-3(July 1966).

The study of the $\bar{\nu}_\mu + p \rightarrow n + \mu^+$ process is suggested for the determination of the pseudoscalar coupling constant f between nucleons and ν_e. The V−A phenomenological-weak-interaction theory and the weak-vector-current-conservation assumption is adopted to calculate the absorption cross section of this reaction. All the higher terms are preserved in the calculations. Three curves of the angular distribution with different values of f are given. (J.F.P.)

34944 SOFT PION THEOREMS AND THE K_{l3}, K_{l4} FORM FACTORS. Berman, S. M.; Roy, P. (Stanford Linear Accelerator Center, Calif.). Phys. Lett., 27B: 88-91(June 10, 1968).

Theoretical arguments are given, based on current-algebras and the smoothness property of the K_{l4} decay form-factors, which imply that the parameter ξ of K_{l3} decay has the value −1 and is approximately constant over the decay region. (auth)

34945 NOTE ON HIGH-p_T EVENTS IN COSMIC RAYS. Peaslee, D. C. (Australian National Univ., Canberra). Nuovo Cim., 55B: 562-5(June 11, 1968).

A study is made of an interaction process around 10^{14} ev characterized by high transverse momenta. The weak interaction is taken as responsible and a comparison is made of the hadron or lepton as recipient of the high transverse momenta, each in the presence of the intermediate boson or its absence. It is emphasized that detailed measurements of these high-energy phenomena might offer an opportunity to decide the existence of the W meson. (J.F.P.)

34946 S-OPERATOR THEORY OF WEAK INTERACTIONS. Bierter, W. (Lawrence Radiation Lab., Berkeley, Calif.). Nuovo Cim., 56A: 253-6(July 1, 1968).

The theory of weak interactions is formulated as an S-operator theory, which fulfills the requirement of unitarity. Various difficulties present in the theory are pointed out. (L.B.S.)

Strong (General)

Refer also to abstract 34919.

34947 (JINR-P2-3819) SVERKHPROVODIMOST' V MODELI KVARKOV I METASTABIL'NOST' NUKLONA. (Superconductivity in the Quark Model and the Nucleon Metastability). Malyuta, Yu. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 7p. (In Russian). Dep.

It is shown that nucleon is a superconductive state constructed of three quarks with zero masses. The temperature is calculated, which corresponds to the phase transition of the second type, resulting in decay of nucleon into quarks with the energy release equal to nucleon mass. As a result of the state reconstruction the antileptons may turn out to be the final products of the nucleon decay. (auth)

34948 NEW TEST OF QUARK-MODEL PREDICTIONS OF INFINITE-ENERGY CROSS SECTIONS USING SUPERCONVERGENCE THEORY. Chan, C. H.; George, D. J. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1428. Phys. Rev., 169: 1278-81(May 25, 1968). (COO-1428-43).

The quark model predicts that certain combinations of total cross sections should be equal at infinite energy. One such prediction is that $\bar{\sigma}_\pi(\infty) = {}^2\!/_3\bar{\sigma}_N(\infty)$, where $\bar{\sigma}_\pi(\nu) = {}^1\!/_2[\sigma_{\pi^+p}(\nu) + \sigma_{\pi^-p}(\nu)]$ and $\bar{\sigma}_N(\nu) = {}^1\!/_4[\sigma_{pp}(\nu) + \sigma_{pn}(\nu) + \sigma_{pn}(\nu) + \sigma_{pn}(\nu)]$ are the average pion-nucleon and nucleon-nucleon cross sections, respectively, and ν is the laboratory beam energy. This prediction is tested by using the implied superconvergence of the forward scattering amplitude $\bar{T}_\pi(\nu) - {}^2\!/_3\bar{T}_N(\nu)$, where $\bar{T}_\pi(\nu)$ and $\bar{T}_N(\nu)$ are defined in an analogous way. It is found that the sum rule is badly violated in the laboratory frame with pions as the beam but satisfied in the "antilaboratory frame" with protons as the beam. It is concluded that the quark-model prediction is correct so long as it is interpreted in the antilaboratory frame. (auth)

34949 QUARK MODEL FOR MESONS AND BARYONS. Kokkedee, J. J. J. (CERN, Geneva). Ned. Tijdschr. Natuurk., 34: 5-24(Jan.-Feb. 1968). (In Dutch).

The most important results of the quark model are described on the basis of a literature study. The hadron as a bound state of quarks is described. The electromagnetic properties of hadrons are derived, and the scattering of hadrons at high energy is analyzed. 35 references. (J.S.R.)

34950 HADRON-DECAY WIDTHS. Weare, T. J. (Imperial Coll. of Science Tech., London). Nuovo Cim., 56A: 64-76(July 1, 1968).

Using a covariant formalism two-body decays are parametrized in terms of coupling constants and, for practical purposes, the lowest-order "angular momentum" barrier coupling is assumed to dominate. From a knowledge of the baryon decays an estimate of the order of magnitude of the interaction radius involved in strong decays is obtained and this is used to test the feasibility of the narrow widths of recently reported high-spin meson resonances (R, S, T, U). (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 35017 and 35085.

34951 (AD-665663) EQUATION FOR MESON STATES IN THE QUARK MODEL AND ITS APPLICATION TO A MESON BOOTSTRAP. King, Lawrence Gray (Illinois Univ., Urbana. Dept. of Physics). Feb. 20, 1968. Contract N00014-67-A-0305-0005. 50p. CFSTI.

A differential equation for meson states is derived from the Bethe–Salpeter equation under the conditions of the quark model. The equation is shown to imply mass relations of the form $K^{*2} - \rho^2 = K^2 - \pi^2$. The equation is used to attempt modified bootstrap calculations of the vector and pseudoscalar meson parameters in the quark model. A bootstrap is found for the SU(3) singlet states but shown not to be possible for either the octet states or the entire Q-bar Q system. The potential is the Fourier transform of the sum of one meson exchange Feynman graphs, with a hard core radius r_0 introduced as an adjustable parameter. (auth)(USGRDR)

34952 (JINR-E2-3793) K-K AND π-K SCATTERING LENGTHS. Micu, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 9p. Dep.

An expression for the K-K low-energy scattering amplitude in accordance with the general requirements of the Bose statistics, crossing symmetry and unitary spin conservation is proposed. The π-K scattering lengths are evaluated by taking into account the scalar meson contribution. (auth)

34953 (UCRL-18232) UNITARITY AND FINITE ENERGY SUM RULES. Arbab, Farzam (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 21, 1968. Contract W-7405-eng-48. 37p. Dep. CFSTI.

Thesis.

Unitarity, analyticity, Regge asymptotic behavior, and a resonance approximation are combined to derive a new sum rule. The sum rule is very convergent; the contribution of high-mass resonances is suppressed by a decreasing weight function. The spin-flip and nonspin-flip residues of the ρ meson in the $\pi\pi \rightarrow N\bar{N}$ amplitude are evaluated at the mass of the ρ, and in conjunction with the first-moment finite-energy sum rule a calculation of the ρ-meson mass is performed. The results are in good agreement with experiment. The sum rule is then applied to the calculation of the $\rho_-$and f_0 resonance parameters in the $\pi\pi \rightarrow \pi\pi$ amplitude. A discussion of the behavior of the sum rule near the elastic threshold is also included. This discussion may give some insight into the nature of the approximations involved in the derivation of the sum rule. (auth)

34954 RESONANT STATES OF $K\bar{K}$ AND KK. Xu, Bo-wei (Lanchow Univ., Kansu, China). Chin. J. Phys. (Peking) (Engl. Transl.), 22: 637(Jan. 1968).

Translated from Wu Li Hsueh Pao, 22: 840-1(July 1966).

A unified consideration of the 1000- to 1040-MeV resonance with $TJ^P = 00^+$ and the 1020-MeV resonance with $TJ^P = 01^-$ which are resonant states of $K\bar{K}$, a $K\bar{K}$ resonance at 1060 MeV with T = 1 and a KK resonance at 1275 MeV with T = 1 is presented from the dynamical point of view, and a further analysis of the space quantum numbers of the 1060 and 1275 MeV resonant states is given. (J.F.P.)

34955 THE A_1 ENHANCEMENT AND RECOUPLING EFFECTS. Gleeson, A. M.; Meggs, W. J. (Syracuse Univ., N. Y.). Nuovo Cim., 55A: 584-9(June 1, 1968). (SU-1206-139).

A mechanism is described to explain the anomalous experimental situation which characterizes the A_1 enhancement in the three-pion mass spectrum. The mechanism is based on two observations: the pions composing the three-pion system are Bose particles and must satisfy suitable symmetrization criteria; and a two-pion subsystem of the tripion system has been experimentally selected to be a ρ-meson. The Jacob and Wick helicity formalism for three-body states is used to investigate the kinematic effects of these two criteria. (L.B.S.)

34956 APPROXIMATE SATURATION OF $\rho-\pi$ SUPERCONVERGENCE RELATIONS. Amann, R. F. (Univ. of Chicago). Nuovo Cim., 55A: 482-8(June 1, 1968). (COO-264-415).

The superconvergent, double spin-flip, sum rule for $\rho-\pi$ scattering is saturated at t = 0, together with its first derivative at t = 0. The particles corresponding to the two lowest multiplets of the rest symmetry $U_6 \otimes U_6 \otimes O_3$ are used in the saturation. Where possible, experimental values for masses and coupling constants are inserted. A bound is obtained for the ratio of d-wave to s-wave coupling for the $A_1 \rightarrow \rho\pi$ decay. The effect of higher resonances is considered briefly, and the consistency of the saturation with the related current algebra sum rules is discussed. (auth)

34957 CURRENT-ALGEBRA CALCULATION OF THE DECAY PROCESSES $\varphi \rightarrow K + \bar{K}$, $K_A \rightarrow K + \omega$, AND $K_A \rightarrow K + \rho$. Lai, C. S.; Young, Bing-lin (Indiana Univ., Bloomington). Phys. Rev., 169: 1241-8(May 25, 1968).

The new technique of Schnitzer and Weinberg for treating hard-pion processes is applied to the calculation of processes involving K mesons. Each decay formula obtained in this approach is a function of the ratio F_K/F_π and a free parameter. By fitting the experimental data on the decay widths, it is found that the ranges of the parameters entering in the present calculation agree with the range of parameter found by Schnitzer and Weinberg. It is also found that the value of F_K/F_π lies in the range of 1.10 to 1.15. (auth)

34958 SOME CONSIDERATIONS ON THE INTERMEDIATE-BOSON HYPOTHESIS AND CP NONCONSERVATION. Pakvasa, S. (Univ. of Hawaii, Honolulu); Tuan, S. F.; Wu, Tai Tsun. Phys. Rev. Lett., 20: 1546-9(June 24, 1968).

The consequences of the assumptions that (1) the intermediate boson W has pair strong interactions and (2) $W^{\pm} = a^{\pm}$ particles of Lee (thus leading to CP nonconservation) are studied and found to lead to a consistent picture. (auth)

34959 NONLINEAR SUM RULES FOR HIGH-ENERGY HADRON–HADRON COLLISIONS IN THE QUARK MODEL. De Souza, P. D.; Heinz, R. M.; Lichtenberg, D. B. (Indiana Univ., Bloomington). Phys. Rev., 169: 1165-7(May 25, 1968).

By assuming that quark-quark double scattering contributes appreciably to high-energy hadron-hadron scattering, a quadratic and a cubic sum rule is obtained for hadron-hadron total cross sections. These sum rules are found to agree with experiment at an incident hardon momentum of 16 BeV/c. (auth)

34960 MESON–MESON COUPLING CONSTANTS FROM PARTIAL CONSERVATION OF AXIAL-VECTOR CURRENT IN BROKEN SU(3). Watal, C.; Agarwal, B. K. (Univ. of Allahabad, India). Phys. Rev., 169: 1384-5(May 25, 1968).

Using the partial conservation of axial-vector current (PCAC) relation, an expression was obtained for determining the couplings of vector mesons to two pseudoscalar mesons. The results are compared with the sum rules following from first-order symmetry. The decay width for $\phi \rightarrow K\bar{K}$ was evaluated and compared with experiment. (auth)

34961 DECAY WIDTHS OF K RESONANCES FROM A RELATIVISTIC QUARK MODEL. Kuriyan, Jacob G.; Suzuki, Mahiko (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 169: 1385-9(May 25, 1968).

The decay widths of K resonances are calculated in two relativistic quark models, using a unitary irreducible representation of the SL(2,C) group. The first model that is used (essentially due to Gell-Mann) considers the K meson to consist of an active (nonstrange) quark and an inert (strange) quark. The SL(2,C) group enters in an essential way to describe the orbital excitations of the K-meson tower. The second model, where the (strange) antiquark and the (nonstrange) quark are treated on an equal footing, involves the use of the two Dirac representations and an SL(2,C) representation. In the second model there is one free parameter, and it is possible to fit satisfactorily the decay rates of $K^* \to K\pi$, $K_T \to K\pi$, $K_T \to K^*\pi$, and $K_A \to K^*\pi$. The possible generalization of this model to describe other hadrons is also discussed. The ratio of the s to d wave is predicted for the $K_A \to K^*\pi$ decay. (auth)

34962 K_A, K^*, AND ϕ DECAY CALCULATIONS WITH HARD KAONS. Fenster, S. (Argonne National Lab., Ill.); Hussain, Faheem. Phys. Rev., 169: 1314-21(May 25, 1968).

The strong decays of K_A, K^*, and ϕ mesons are calculated using (a) Ward identities derived from equal-time commutation relations of chiral SU(3) ⊗ SU(3), (b) the notion of a partially conserved strangeness-changing axial-vector current, (c) dominance of spectral functions by gauge mesons, and (d) maximum smoothness of proper vertex functions. This method was originally introduced by Weinberg and Schnitzer for SU(2) ⊗ SU(2) and applied to A_1 and ρ decays. We describe the ω-ϕ system by the current-mixing model. The resonance contribution to the K_A-decay Dalitz plot is obtained. (auth)

34963 SPIN-PARITY ANALYSIS FOR BOSON RESONANCES. Chung, Suh Urk (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 169: 1342-52(May 25, 1968).

A general helicity formalism is developed for the determination of spin and parity of boson resonances of arbitrary spin which have sequential decay modes. The procedure is illustrated with a few simple but, in practice, important decay modes, namely, $1^- + 1^-$, $1^\pm + 0^-$, and $2^+ + 0^-$, where $1^\pm$ and 2^+ mesons in turn decay into 2 or 3 pseudoscalar mesons. The method proposed here is independent of the dynamics of the production and decay process. (auth)

34964 LOW-ENERGY PION–PION INTERACTION. Dutta-Roy, Binayak; Lapidus, I. Richard (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev., 169: 1357-62(May 25, 1968).

Low-energy pion-pion scattering is assumed to be dominated by the ρ resonance in the I = 1, J = 1 channel, the f^0 resonance in the I = 0, J = 2 channel, and a broad resonance of mass about 700 MeV in the I = 0, J = 0 channel. This simple model is found to be in substantial agreement with: (a) Adler's sum rule for pion-pion scattering, (b) the $K_1^0 - K_2^0$ mass difference, (c) t-channel contributions to backward pion-nucleon dispersion relation, (d) Malamud and Schlein's "experimental" determination of the pion-pion phase shifts, (e) constraints on the s-wave pion-pion phase shifts at the K mass deduced from the two pion decays of the neutral K mesons, (f) characteristics of the K_{e4} decay, and (g) odd-pion spectral shape for K decay into three pions. (auth)

34965 SOFT MESON APPROXIMATION AND THE DECAYS OF TENSOR MESONS. Miura, Kimio (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 1070-2(Apr. 1968).

The observed partial decay widths of the tensor mesons, A_2(1320), K_V(1420), f(1250), and f′(1500), are compared with theoretical predictions based on the soft meson approximation, the nonet theory, and the PCAC hypothesis. The agreement with experiment is good except for $\Gamma(f' \to K\bar{K})$. (L.B.S.)

34966 SUPERCONVERGENT BOOTSTRAP OF THE VECTOR AND TENSOR REGGE TRAJECTORIES. Matsuda, Satoshi Tokyo Univ.). Phys. Rev., 169: 1169-72(May 25, 1968).

A dynamical scheme proposed by Mandelstam, based on rising Regge trajectories, the narrow-resonance approximation, and generalized superconvergence relations, is applied within exact SU(3) to the amplitude for V + P → P + P, where P and V stand for pseudoscalar and vector mesons. It is shown that the coupled vector- and tensor-octet trajectories can indeed bootstrap themselves satisfactorily. The vector-octet trajectory is also shown to bootstrap itself. The interesting mass formula $3\mu_{V^2} = \mu_{T^2} + 3\mu_{P^2}$ is also obtained, where μ_{M^2} represents the average mass squared of the M-meson octet, and T stands for tensor mesons. (auth)

34967 MASSES OF BOSONS WITH HIGHER SPINS AND THE SPECTRAL FUNCTION SUM RULES. Iwao, Syurei (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 1083-4(Apr. 1968).

A possible realization of the spectral representation of boson fields carrying spin greater than 2 is discussed. A relation for the mass eigenvalues predicted by this theory is compared with the semi-empirical relation based on the theory of complex momenta and leads to a reasonable agreement. (L.B.S.)

34968 BOSON FIELDS WITH NONLINEAR SELF-INTERACTION IN TWO DIMENSIONS. Glimm, James (Massachusetts Inst. of Tech., Cambridge). Commun. Math. Phys., 8: 12-25 (1968).

Semiboundedness of the total Hamiltonian is proved for a selfinteracting boson field in two dimensional space time. The interaction is given by a Wick polynomial: $P(\Phi)$:. The polynomial P is required to have even degree and its leading coefficient must be positive. A space cutoff is introduced in the interaction Hamiltonian. (auth)

34969 RECIPROCAL BOOTSTRAP OF THE VECTOR AND TENSOR TRAJECTORIES FROM SUPERCONVERGENCE. Ademollo, M. (Harvard Univ., Cambridge, Mass.); Rubinstein, H. R.; Veneziano, G.; Virasoro, M. A. Phys. Lett., 27B: 99-102(June 10, 1968).

A systematic study of the reactions $P_8P_8 \to P_8V_9$ and $P_8P_8 \to P_8T_9$ with V_9T_9 intermediate trajectories yields a system of 13 equations, whose solution contains exchange degeneracy of the trajectories, the mass formula $m^2_{A_2} = 3(m_\rho^2 - m_\pi^2)$, decoupling of the Pomeranchuk to PT, $g_{\rho\pi\phi} \approx 0$, $g_{f^*\pi\pi} \approx 0$, and strong restrictions on possible SU_3 representations suggesting a reciprocal bootstrap of the T_9 and V_9 trajectories. A general scheme for meson bootstrap is discussed. (auth)

34970 $\bar{p}p$ CHARGE EXCHANGE AT HIGH ENERGIES. Polgar, E. E. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys.Acta, 41: 451-86(July 1, 1968). (In German).

The charge exchange reaction $\bar{p}p \to \bar{n}n$ was investigated with a large magnet spark chamber. The experimental procedure and the analysis are described. The results obtained on the total and differential cross section at 5, 6, 7 and 9 GeV/c are presented. Comparison is made with other charge exchange processes. Theoretical models are discussed. (auth)

34971 SUPERCONVERGENCE RELATION FOR A LINEAR COMBINATION OF AMPLITUDES. Seth, V. P.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim., 55A: 842-3(June 21, 1968).

Superconvergence relations are written for a linear combination of two amplitudes for meson-meson scattering using SU(3) symmetry. (L.B.S.)

34972 SUPERCONVERGENCE RELATIONS FOR $\bar{N} + N \to \pi + \rho$ AND $\bar{N} + N \to \pi + \omega$. Bartl, A. (Univ., Tuebingen, Ger.); Widder, F. Nuovo Cim., 55A: 618-26(June 21, 1968).

Superconvergence relations for $\bar{\mathcal{N}} + \mathcal{N} \to \pi + \rho$ and $\bar{\mathcal{N}} + \mathcal{N} \to \pi + \omega$ are considered which follow from high-energy behavior. Saturating these relations with a number of low-lying states $g_{\varphi\mathcal{N}}/g_{\omega\mathcal{N}} \simeq 0.06$, and $m_\omega = m_\rho$ and $g_{\rho\omega\pi} = 21\ (\mathrm{GeV})^{-1}$ are obtained in good agreement with experiment. Assuming ρ-meson universality and vector-meson dominance $g_{\rho\mathcal{N}} = 2.8$, $g_{\omega\mathcal{N}} = 6.4$, for $f_{\rho\mathcal{N}} = 10.3$ in agreement, and $f_{\omega\mathcal{N}} = 4.0$ in disagreement with the results of a least-squares fit of low-energy $\mathcal{N} - \mathcal{N}$ data. (auth)

34973 SPECTRAL-FUNCTION SUM RULES FOR TENSOR FIELDS. Raman, K. (Brown Univ., Providence). Contract AT(30-1)-2262. Nuovo Cim., 55A: 650-5(June 21, 1968). (NYO-2262TA-168).

Sum rules are derived for the spectral function of tensor fields. Some consequences of saturating these with simple low-lying states are discussed. (auth)

34974 SUM RULES FOR $\pi\pi$ SCATTERING. Baranov, A. I.; Vall, A. N.; Serebryakov, V. V. (Inst. of Mathematics and Computer Center, Novosibirsk, USSR). Yadern, Fiz., 7: 870-5(Apr. 1968). (In Russian).

A number of sum rules are obtained for pion-pion partial wave amplitudes on basis of the low-energy interpretation of the dispersion relations at fixed momentum transfer. From these sum rules a relation of scattering lengths to parameters of known resonances and high-energy contributions follows as well as an indication to the presence of a new dipion resonance with I = 0 and J = 4 near 2 GeV. (auth)

34975 $O_{3,1}$ SYMMETRY AND THE HIGH-ENERGY REACTIONS $N\bar{N} \to Y\bar{Y}$. Antoniou, N. G.; Palev, C.; Samiullah, M. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 56A: 77-82(July 1, 1968). (IC-67/76).

A study of the high-energy reactions $N\bar{N} \to Y\bar{Y}$ is presented within the framework of $O_{2,1}$ partial-wave expansion formalism for arbitrary momentum transfer. It is found that the high-energy helicity amplitudes receive contributions from both $j_0 = 0$ and

$j_0 = 1$ Lorentz poles. It is also found that the angular distribution has a minimum around the points $t \simeq -0.3\ (\mathrm{GeV}/c)^2$ and $t \simeq -1.4\ (\mathrm{GeV}/c)^2$. The predictions are compared with the results of the absorption model and with the experimental data for momentum of the incident antiproton $P_L = 5.7$ (GeV/c). (auth)

34976 ρ-MESON DOMINANCE AND CURRENT ALGEBRA. Ahmed, M. A. (CERN, Geneva). Nuovo Cim., 56A: 197-206 (July 1, 1968).

The ideas of vector-meson dominance as applied to three- and four-point functions are combined with those of current algebra in a simple situation. It is found in particular that the slow variation assumption of three-point functions can be justified. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 34865, 34916, and 35388.

34977 (AD-666680) DISPERSION RELATIONS IN HIGH-ENERGY PHYSICS. Final Report, November 1, 1964–September 30, 1967. Massey, Harrie (University Coll., London (England). Dept. of Physics). Oct. 31, 1967. 16p. (AFOSR-68-0519). CFSTI.

A phase shift analysis of pion-nucleon scattering up to 1.5 GeV was made which revealed quantity of resonance structure. Low-energy pion photoproduction is now almost completely understood in terms of pion-nucleon scattering. Strange particle coupling constants were evaluated and shown to be consistent with pseudoscalar SU(3). Several mathematical contributions to the study of dispersion relations were made. (auth)(USGRDR)

34978 (DESY-68/18) STUDY OF $\pi^-\pi^-$ ELASTIC SCATTERING IN THE REACTION $\pi^-p \rightarrow N^{*++}\pi^-\pi^-$ AT 11 GeV/c. Caso, C.; Conte, F.; Tomasini, G.; (and others). (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr. 1968. 26p. Dep.

Experimental data on the reaction $\pi^-p \rightarrow N^{*2+}\pi^-\pi^-$ are presented. For events with low momentum transfers ($\Delta^2 < 0.3(\mathrm{GeV}/c)^2$) the nonresonant background in the N^{*2+} region is about 19%. Applying different versions of the OPE model, values for the elastic $\pi^-\pi^-$ cross section for energies of the $\pi\pi$ system up to 1.72 GeV are obtained. Distributions of the $\pi\pi$ scattering angle are shown for different regions of the $\pi^-\pi^-$ energy. (auth)

34979 (ITF-68-1) SPECTRAL REPRESENTATION OF AMPLITUDE-LIKE QUANTITIES. Pisarenko, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 36p. Dep.

A spectral representation is obtained for the vacuum expectation of the causality commutators of two divergences of the axial current. Some properties of spectral density following from the PCAC hypothesis are considered. (auth)

34980 (JINR-P4-3800) MEZON-YADERNYE VZAIMODEISTVIYA PRI OCHEN' VYSOKIKH ENERGIYAKH. (Meson-Nuclei Interaction at Very High Energies). Artykov, I. Z.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 10p. (In Russian). Dep.

Inelastic interactions of π-mesons with the emulsion nuclei at an average energy of 200 GeV are considered by means of the intranuclear cascade model. It is taken into account that several fast particles can interact simultaneously with one internuclear nucleon. The number of such many-particle interactions is more than a third from the total number of elastic and inelastic collisions of fast particles inside the nucleus. The results of calculations agree well with experiment. (auth)

34981 (LNF-68/5) KINEMATICAL CONSTRAINTS, FACTORIZATION AND KINEMATICAL ZEROS. [PART] I. Note No. 390. Di Vecchia, P.; Drago, F.; Paciello, M. L. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Feb. 28, 1968. 19p. Dep.

The kinematical constraints at t = 0 are derived for an important class of reactions. The factorization requirements for the Regge pole residue functions are studied. The "minimal" behavior at t = 0 of the Regge residue functions, consistent with the kinematical constraints and the factorization, is given. The results are compared with those obtained in the group theoretical approach. (auth)

34982 (NP-17490) FINITE ENERGY SUM RULES AND THE CROSSOVER PROBLEM IN K-N SCATTERING. Note No. 156. Di Vecchia, P.; Drago, F.; Paciello, M. L. (Rome Univ. (Italy). Istituto di Fisica). Feb. 6, 1968. 13p. Dep.

The behavior of the ω-residue functions in kaon-nucleon elastic scattering is studied using the "finite energy sum rules" technique. It is found that both spin flip and nonspin flip ω-residues show a zero near $t \sim -0.1\ (\mathrm{GeV}/c)^2$: this is in agreement with the usual explanation of the crossover phenomena in KN and NN elastic scattering, but in contradiction with the behavior of the ω-residue functions deduced from other reactions. (auth)

34983 (UCRL-18201) THE $K^+p \rightarrow K^+\pi^-\Delta^{++}$ INTERACTION AT 4.6 AND 9 BeV/c. Fu, C.; Firestone, A.; Goldhaber, G.; Trilling, G. H.; Shen, B. C. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 18, 1968. Contract W-7405-eng-48. 14p. (CONF-680428-2). Dep. CFSTI.

From Conference on Experimental Meson Spectroscopy, Philadelphia, Pa.

An attempt is made to test the extent to which the entire reaction $K^+ + p \rightarrow K^+ + \pi^- + \Delta^{2+}(1236)$ can be understood on the basis of one pion exchange domination modified by absorption effects. It is found that at least three and possibly four distinct effects are needed to interpret the experimental results. These are: $K^*(890) + \Delta^{2+}$, where the $K^*(890)$ exhibits the well-known p-wave $K\pi$ scattering features with some s-wave interferences, $K^*(1420) + \Delta^{2+}$, where the $K^*(1420)$ shows the features corresponding to d-wave $K\pi$ scattering and thus $J^P = 2^+$, a $\pi^-\ \Delta^{2+}(1238)$ enhancement in the mass region 1400 to 1700 MeV, and the question of whether there is evidence for a 0^+ $K\pi$ resonance. (J.F.P.)

34984 SELECTION CRITERIA FOR πN COLLISIONS. Azimov, S. A.; Rechitskii, I. V. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 10, 21-4(1967). (In Russian).

Collisions π-N with secondary charged particles $n \geq 4$ and a slow recoil proton were studied in Il'ford G5 photoemulsions irradiated by 17.2-GeV/c pions. The selected stars contained only one recoil proton with the kinetic energy from 20 to 400 MeV (momentum 218 to 954.1 MeV/c). The rest of the charged particles in the star had ionization lower than the indicated proton energy (in such case their velocity $\beta \geq 0.7131$). However, in a few cases in which in addition to the proton, the pion had $\beta < 0.7131$, the indentification and energy determination was carried out for both tracks. Two hundred and twenty two stars with slow protons flying into the frontal hemisphere were analyzed and a Chew-Low diagram is given. (R.V.J.)

34985 $O_{3,1}$ SYMMETRY AND THE LORENTZ STATES OF EXCHANGED TRAJECTORIES FOR $0 + \frac{1}{2} \rightarrow 1 + \frac{3}{2}$ SPIN PROCESSES. Komy, S. R. (International Centre for Theoretical Physics, Trieste, Italy); Samiullah, M.; Mahanta, P. Nuovo Cim., 55A: 423-32(June 1, 1968).

A study of the $0 + \frac{1}{2} \rightarrow 1 + \frac{3}{2}$ spin processes was made in the Delbourgo, Salam and Strathdee $O_{3,1}$ partial-wave expansion formalism for arbitrary t. It is observed that the helicity amplitudes receive contributions which depend on the different j_0 values. A mechanism to understand this phenomenon is proposed and its implications and consequences discussed. (auth)

34986 APPLICATION OF FINITE ENERGY SUM RULES TO πN SCATTERING NEAR THE BACKWARD DIRECTION. Chiu, C. B. (Univ. of California, Berkeley); DerSarkissian, M. Nuovo Cim., 55A: 396-411(June 1, 1968).

It is found that the Regge-pole parameters obtained through a sum-rule integral over the low energy πN data (phase shifts up to $T_\pi = 1.3$ GeV) and over the ρ-pole contribution in the t-channel, near u = 0, are compatible with the available Regge parameters obtained at high energy. In particular in the interval from u = 0.1 to $-0.35\ (\mathrm{GeV})^2$ a zero is predicted in the scattering amplitude associated with the nucleon (N_α) trajectory exchange and no zero is predicted in the scattering amplitude associated with Δ exchange. The coupling of the N_γ trajectory is weak throughout this region. (auth)

34987 LOW-ENERGY SCATTERING AND HIGH-ENERGY LIMITS. Oehme, R. (Univ. of Chicago). Nuovo Cim., 55A: 595-8(June 1, 1968).

The πN charge-exchange amplitude $F^-(\nu,t)$ is studied in dispersion theory for energies above 2 GeV. It is shown that the meromorphic expansion of $f^-(\nu,t)$ in both variables in the neighborhood $(\nu,t) = (\mu,0)$ would include both ν- and t-singularities, and gives rise to nonpole terms. The ρ-pole dominance of amplitudes in the t-channel is discussed. (L.B.S.)

34988 POLARIZATIONS AT VERY HIGH ENERGIES. Mickens, R. E. (Vanderbilt Univ., Nashville). Nuovo Cim., 55A: 599-601(June 1, 1968).

The very-high-energy behavior of the polarization for pseudoscalar-meson interactions with nucleons is discussed in the Regge formalism. (L.B.S.)

34989 SUM RULES AND P + P' REGGE MODEL OF πp SCATTERING. Logan, R. K.; Razmi, M. S. K. (Univ. of Toronto). Nuovo Cim., 55A: 577-80(June 1, 1968).

The superconvergent form of the inverse dispersion relation of Gilbert (Phys. Rev. 108: 1078 (1957)) is used to determine the πp parameters of the P and P′ Regge poles. The high-energy total cross sections and the ratio of the real to imaginary part of the forward pion–nucleon scattering amplitudes are predicted. (L.B.S.)

34990 SUPERCONVERGENT SUM RULE FOR FACTORIZED AMPLITUDES. Seth, V. P.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim., 55A: 581-3(June 1, 1968).

A superconvergent sum rule obtained by factorizing the Regge amplitudes for two inelastic meson–baryon interactions that have the same t-channel trajectory is examined for the case where one of the processes is elastic and the other is inelastic. The processes $KN \rightarrow KN$ and $\pi N \rightarrow \eta N$ are considered. (L.B.S.)

34991 ON ENERGY- AND MOMENTUM-TRANSFER DEPENDENCE IN $\pi p \rightarrow \rho N^*$. Donohue, J. T. (CERN, Geneva). Nuovo Cim., 55A: 527-33(June 1, 1968).

The effects on energy- and momentum-transfer dependence of cross sections, caused by the variation of Δ^2_{min} with incident momentum and external masses, are investigated using a simple model for the differential cross section. It is found that at intermediate momenta, ~(3 to 6) GeV/c the incident momentum dependence of the total cross section for $\pi p \rightarrow \rho N^*$ differs appreciably from that of the differential cross section. The consequences for the Δ^2 distributions of a zero near $\Delta^2 = 0$ are examined, and it is found that plotting in $\Delta^2 - \Delta^2_{min}$ should be used to resolve this question. (auth)

34992 STRONG DECAYS OF HIGHER BARYONS IN A QUARK MODEL. Katyal, D. L. (National Physical Lab., New Delhi. Univ. of Delhi); Mitra, A. N. Phys. Rev., 169: 1322-9(May 25, 1968).

An SU(6) × O(3) model of baryons, which had earlier been used by Mitra and Ross for the evaluation of the strong decay widths of negative parity $(70,1^-)$ baryons, is now extended to higher-lying baryonic states assumed to belong to the $(56,2^+)$ and $(70,3^-)$ representations, as Regge recurrences of the supermultiplets $(56,0^+)$ and $(70,1^-)$, respectively. Four different classes of supermultiplet transitions are examined. For the transitions $(56,2^+) \rightarrow (56,0^+)$, the results are in broad agreement with experiment, as well as those of $SU(6)_W$ and previous quark-model calculations. For the transitions $(56,2^+) \rightarrow (56,2^+)$ and $(56,2^+) \rightarrow (70,1^-)$, appreciable widths are predicted for several experimentally observable states, the first type being geometrically related to the $N^*N\pi$ coupling constant, and the second type being shown to involve a symmetry transition of only one unit (from symmetric to mixed symmetric wave functions). Results are also given for transitions from $(70,3^-)$ states. (auth)

34993 NEW TYPE OF DISPERSION-THEORY SUM RULE. Atkinson III, R. (Tufts Univ., Medford, Mass.). Phys. Rev., 169: 1293-5(May 25, 1968).

It is shown that a new class of sum rules can be obtained by comparing, for example, fixed-t and fixed-u dispersion relations. In particular, if an amplitude obeys both fixed-t and fixed-u dispersion relations at t^* and u^*, respectively, a sum rule is obtained by equating the two dispersion relations for the amplitude evaluated at t^* and u^*. Under special circumstances the no-subtraction requirement can be lifted. The procedure is applied to the $A^{(-)}$ and $B^{(-)}$ πN amplitudes to derive new sum rules, and it is shown that these sum rules are reasonably well satisfied with only ρ, N, and N^* contributions for the choice $t^* = u^* = 0$. (auth)

34994 SU(6) INVARIANCE IN s-WAVE MESON–BARYON SCATTERING. Carey, David C. (Univ. of Michigan, Ann Arbor). Phys. Rev., 169: 1368-83(May 25, 1968).

SU(6) is incorporated into a simple model of a multichannel amplitude for s-wave scattering of mesons in the 35 representation by baryons in the 56. Symmetry breaking is introduced by making the amplitude satisfy unitarity exactly in the direct channel. The contributions to the amplitude from the crossed-channel singularities are assumed to be SU(6)-invariant, and can be expressed in terms of four scattering lengths by the use of appropriate projection matrices. Fits of the model are made to the threshold parameters of πN, KN, and $\overline{K}N$ scattering. Several solutions are found, and a comparison of calculated threshold parameters, cross sections, and phase shifts with experimental data is made. Calculations of resonances predicted by the model are performed and found to be in good agreement with experimental results. (auth)

34995 TESTS OF SATURATION IN STRONG COUPLING THEORY. North, Gerald R. (Univ. of Pennsylvania, Philadelphia). Contract AT(30-1)-2171. Phys. Rev., 169: 1231-3 (May 25, 1968). (NYO-2171-239).

Saturation of sum rules is tested in several strong-coupling static models, and the results are compared with the known properties of the models. A meson current commutation relation is very poorly saturated by low-lying states. Superconvergence relations are discussed in both s- and p-wave models. There are no such relations in s-wave models, but there are two in the p-wave model, one of which is saturated, the other not. It is also shown that certain truncated Chew-Low equations have no solutions. (auth)

34996 REGGE PARAMETERS OF P AND P′ FROM SUM RULES. Logan, R. K.; Razmi, M. S. K. (Univ. of Toronto). Phys. Rev., 169: 1167-8(May 25, 1968).

Sum rules are derived from dispersion and superconvergence relations to obtain two relations between the P and P′ parameters. A one-parameter fit to the πp total cross section and the ratio of the real to the imaginary part of the πp scattering amplitude is performed. (auth)

34997 NONANALYTICITY OF THE SCATTERING AMPLITUDE AT u = 0 IN A RELATIVISTIC HARMONIC-OSCILLATOR MODEL. Cocho, G. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., 169: 1124-8(May 25, 1968).

Within the framework of a model based on the noncompact group U(3,1), scattering amplitudes are calculated in the Born approximation using a phenomenological propagator in which an infinite number of one-particle states are exchanged. The amplitude is found to be nonanalytic at the point where the squared mass of the internal line changes sign (u = 0). The possibility of testing such anomalous behavior in pion-nucleon backward scattering and in other processes is discussed. (auth)

34998 NONVANISHING ASYMPTOTIC TOTAL π-N CROSS-SECTIONS FROM CONTINUOUS MOMENT SUM RULES. Della Selva, A.; Masperi, L.; Odorico, R. (IAEA, Trieste, Italy). Nuovo Cim., 55A: 602-8(June 1, 1968).

The P and P′ Regge parameters are determined using information derived from the high-energy total πN cross section data together with results of a continuous family of sum rules. The t = 0 intercept of the Pomeranchuk trajectory was determined to be 1 with an uncertainty of 0.02 to 0.03. (L.B.S.)

34999 NONLEPTONIC DECAYS OF HYPERONS ON THE BASIS OF ALGEBRA OF CURRENTS, ASYMPTOTIC SU(3), REGGE POLES, AND DISPERSION RELATIONS. Okubo, S. (Univ. of Rochester, N. Y.). Ann. Phys. (N. Y.), 47: 351-76 (1968). (UR-875-226).

Nonleptonic decay of hyperon was investigated from a new viewpoint where, the algebra of currents, asymptotic SU(3) symmetry, Regge poles and dispersion relations are heavily utilized. The use of the ordinary soft-pion technique was avoided as well as the exact validity of the SU(3) symmetry so that the mass differences among baryon octet can be taken into account. In this way, it was found that the dispersion correction ordinarily discarded may really give an equally important or even dominant contribution compared to the result based upon a simple use of the algebra of currents. The final answer is very much similar to the K^*-dominance model of Sakurai for the S-wave decay and it satisfies the Lee–Sugawara triangle as well as $S(\Sigma_{+}^{+}) = 0$, although two different contributions are computed, one which is the ordinary term and the other which comes from the dispersion correction. For the P-wave, the situation appears to be far more complicated than ordinarily believed. (auth)

35000 IMPACT-PARAMETER REPRESENTATION OF PION–NUCLEON SCATTERING AMPLITUDES AT HIGH ENERGIES. Kubo, Reijiro (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 39: 1006-19(Apr. 1968).

A relativistic impact-parameter formalism developed by Adachi and Kotani is applied to evaluating π-N elastic and charge-exchange scattering amplitudes at high energies. On the basis of this formalism, the impact-parameter amplitudes corresponding to spin-flip and spin-nonflip amplitudes are rigorously defined. A simple relation between the spin-flip and the spin-nonflip impact-parameter amplitudes is found by making use of MacDowell's reciprocity relation for partial-wave amplitudes. As a result, if the spin-nonflip amplitude is given as a known analytic function of the total c.m. energy W and the momentum transfer squared −t, then the spin-flip amplitude can be derived from it also as a function of W and −t. It is also found that backward scattering is closely related to forward scattering. To be more precise, it becomes possible that the forward spin-flip amplitude is determined from the backward diffraction shape of the differential cross section. (auth)

35001 EXPERIMENTAL DISCOVERY OF THE NONLOCALITY IN MICROPHENOMENA. Sekine, Matsuo (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto), 39: 1038-46(Apr. 1968).

Pion-nucleon forward elastic scattering is analyzed using the dispersion relations related to the nonlocality. The case is investigated when causality is violated in the neighborhood of the vertex of the light cone. From comparison with the recent Brookhaven experiments, it is shown that there exits an acausal region at a small distance, 0.6 of a meson Compton wavelength, i.e., 0.85×10^{-13} cm. Also the results are compatible with experiments on the charge-exchange forward cross sections. (auth)

35002 NEW DETERMINATION OF THE P AND THE P' REGGE POLE PARAMETERS. Miyamura, Osamu; Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 39: 1000-5(Apr. 1968).

Using Igi's sum rule for pion-nucleon S-wave scattering length and the Brookhaven new data on high energy pion-proton total cross sections, the P and the P′ Regge pole parameters are determined. The asymptotic form of the crossing even πN forward scattering amplitude $M^{(+)}(\nu)$ is given. The numerical results obtained are $\alpha_{P'} = 0.61$, $\sigma_{\pi N}(\infty) = 4\pi B_P/\nu_0 = 19.6$ (mb) and $8\pi B_{P'}/\nu_0 = 30.8$ (mb). α_P and $\alpha_{P'}$ are the intercepts of the P and the P′ Regge pole trajectories at $t = 0$, B_i the relevant residues. The ratio Re $M^{(+)}(\nu)$/Im $M^{(+)}(\nu)$ for $\nu = 8$ to 20 BeV predicted from the above results is in excellent agreement with experiment. (auth)

35003 DETERMINATION OF THE NUCLEON–NUCLEON SCATTERING MATRIX. VII. (p,p) ANALYSIS FROM 0 TO 400 MeV. MacGregor, Malcolm H.; Arndt, Richard A.; Wright, Robert M. (Univ. of California, Livermore). Phys. Rev., 169: 1128-48(May 25, 1968).

All of the available (p,p) scattering data from 1 to 400 MeV have been analyzed, and a self-consistent set of 839 data has been chosen. Using this data selection, a number of different forms for the phase shift energy dependence was investigated. The correct number of free parameters to use with each form was studied. The most suitable form, form A, gave the least-squares values $\chi^2 = 810$ and $\chi^2 = 858$ for 30- and 23-parameter solutions, respectively. A subset of 588 data in six narrow energy bands was used to obtain single-energy solutions. It is shown that this subset contains most of the physical content of the full set of 839 data. The value $g^2 = 14.72 \pm 0.83$ was obtained for the pion-nucleon coupling constant. (auth)

35004 ABSORPTIVE CORRECTIONS AND πN CHARGE EXCHANGE POLARIZATION. White, J. N. J. (Glasgow Univ.). Phys. Lett., 27B: 92-5(June 10, 1968).

A calculation is presented to show that Gottfried-Jackson absorptive factors, modifying Regge ρ exchange, predict a charge exchange polarization which is positive, of the correct order of magnitude and decreasing slightly slower than p_L^{-1} where p_L is the incident ρ laboratory momentum. Since the absorption depends only on the P and P′ poles no extra parameters are introduced. (auth)

35005 SOME CONSEQUENCES OF INFINITE MASS RENORMALIZATION. Zimmermann, Wolfhart (Courant Inst. of Mathematical Sciences, New York). Commun. Math. Phys., 8: 66-88(1968).

Using a finite form of local field equations some consequences of infinite mass renormalization are studied in a rigorous manner. The method is applied to various models. For pseudoscalar meson-nucleon interaction sufficient conditions are given for the equivalence to a direct Fermi coupling. Confirming a recent result by Kroll, Lee, and Zumino it is shown that a vector meson field should be proportional to the corresponding current if the bare meson mass is infinite. In the conventional treatment of neutral vector meson theories this causes certain difficulties which are analyzed in detail. In case of two vector fields coupled to the same current it is found that the fields must be proportional provided the bare masses are both infinite. Finite local field equations are discussed for the coupling of a neutral vector meson field to the current of a spin ½ field. (auth)

35006 RELATIVISTIC SL(6,C) STRONG VERTEX AND KINEMATIC FORM FACTORS. Bamberg, P. G. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 305: 27-53(May 21, 1968).

The SL(6,C) invariant baryon–baryon–meson vertex, involving three infinite multiplets, is expanded in terms of representations of the maximal compact subgroup $SU(6)_p$ for particles of arbitrary momentum. The terms in the expansion which involve the lowest-dimensional SU(6) multiplets are evaluated in closed form. The assumption of SL(6,C) invariance leads to a breaking of SU(6) by spurions in a well-defined way. Each type of spurion coupling is accompanied by a function of momentum which vanishes rapidly for large momentum transfer and can be interpreted as a kinematic form factor. All calculations are performed with the "generalized tensor" formalism, and a number of mathematical results are obtained which greatly simplify the technical problems of dealing with infinite-dimensional group representations. (auth)

35007 PHOTON MESO-PRODUCTION AND ELECTROMAGNETIC COUPLINGS OF BARYONIC RESONANCES. Renard, F. M.; Renard, Y. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim., 55A: 631-49(June 21, 1968).

The reactions with production of photons, meson + nucleon → γ + baryon are considered, in particular for the determination of the electromagnetic couplings of the $(M\text{-}\mathcal{N})$ resonances with charge zero and strangeness equal to zero or minus one. As illustrations the cases of the first $\mathcal{N}^{*0}$ resonances appearing in $\pi^- p \rightarrow \gamma + n$ and of the Y^{*0} resonances appearing in $K^- + p \rightarrow \gamma + \Lambda$ are treated. It is shown how these reactions may be used to test the isospin properties of the electromagnetic interactions, the predictions of quark models, SU_3 symmetry and other models for the classification and for the electromagnetic couplings of the baryonic resonances. Lastly, the reactions with deuteron target $M + d \rightarrow \gamma + B + \mathcal{N}$ are shown to be particularly sensitive to the baryon-nucleon interactions. (auth)

35008 SUM RULES IN COUPLING CONSTANTS IN A DERIVATIVE COUPLING MODEL BY FIELD-THEORETIC METHODS IN BROKEN SU_3. Bose, S. K. (Indian Inst. of Tech., Kanpur). Nuovo Cim., 55A: 627-30(June 21, 1968).

Taking a derivative coupling model for meson-baryon interactions in strong interactions, sum rules in coupling constants were derived by field-theoretic methods in broken SU_3. (auth)

35009 NEUTRAL-MESON PRODUCTION IN A QUARK MODEL. Joshi, G. C. (Univ. of Manchester, Eng.). Nuovo Cim., 55A: 671-8(June 21, 1968).

The production of neutral vector and pseudoscalar mesons is studied in a quark model. The mixing-angle-dependent as well as mixing-angle-independent sum rules are obtained and compared with experiment. For pseudoscalar mesons both possibilities, namely, η-X^0 and E-η mixing, are discussed and using the present model, expected cross sections for E-production in $\pi^- p$ $(\pi^+ n)$ processes are calculated. (auth)

35010 REMARKS ON THE SATURATION OF SUPERCONVERGENCE RELATIONS IN A STATIC MODEL. Aramaki, S. (Nagoya Univ., Japan). Nuovo Cim., 55A: 838-41(June 21, 1968).

It was previously pointed out that the saturation assumption of the superconvergence relation and the bootstrap calculation in the static pion-nucleon model give the same equation connecting the residue of the nucleon pole γ, and the reduced half-width of the (3,3) resonance γ_3. The question of what relationship exists between these two approaches is examined. (L.B.S.)

35011 ON THE W-MESON PRODUCTION CROSS SECTIONS FOR THE REACTIONS $\pi N \rightarrow WN$, $NN \rightarrow NNW$. Folomeshkin, V. N. Yadern. Fiz., 7: 835-9(Apr. 1968). (In Russian).

The W-meson production cross sections for the reactions $\pi N \rightarrow WN$, $NN \rightarrow NNW$ are estimated in framework of the peripheral one-pion model. It is shown that an account of the nucleon form factor for the πNN vertex lowers the $\pi N \rightarrow NW$ cross section by a factor of 20 and the $NN \rightarrow NNW$ by a factor over 3 orders of magnitude, as compared with the case of the point nucleon. The ratio of the W-meson to the $\mu\mu$-pair production cross sections is estimated. It is shown that for $M_W^2 > 2.5$ GeV^2 the number of muons from the decay of the W-meson is more than the number of muons from the production of pairs with the corresponding invariant effective mass. (auth)

35012 SHADOW ELASTIC SCATTERING IN THE MULTI-REGGE-EXCHANGE MODEL. Michejda, L. (Inst. of Nuclear Research, Warsaw); Turnau, J.; Bialas, A. Nuovo Cim., 56A: 241-4(July 1, 1968).

Calculations were made of the imaginary part of the elastic-scattering amplitude as the shadow of the three 8 GeV/c $\pi^+ p$ inelastic channels in the multi-Regge-exchange model, both with and without Regge phases. It is found that the result without phases deviates strongly from results derived from measurement, and that phases of the Regge type may drastically change the result yielding much steeper shadow elastic scattering. (L.B.S.)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 34881, 35006, 35011, and 35154.

35013 CONNECTION BETWEEN HIGH- AND LOW-ENERGY PHENOMENA IN ELASTIC NUCLEON–NUCLEON SCATTERING. Thevenet, Christiane; Predazzi, Enrico (Univ., Lyon. Univ., Turin). Compt. Rend., Ser. A and B, 266: 966-8(Apr. 1, 1968). (In French).

The low energy effects are related to high energy phenomena in such a manner as to improve the theory of elastic nucleon–nucleon scattering at low energy. (tr-auth)

35014 DETERMINATION OF THE NUCLEON–NUCLEON SCATTERING MATRIX. VIII. (p,p) ANALYSIS FROM 350 TO 750 MeV. MacGregor, Malcolm H.; Arndt, Richard A.; Wright, Robert M. (Univ. of California, Livermore). Phys. Rev., 169: 1149-66(May 25, 1968). (UCRL–70075(Pt.8)).

All of the available (p,p) data from 350 to 750 MeV have been analyzed together with matrix representations for the data at lower energies. Several energy-dependent forms for the phase shifts were investigated, including forms using contributions from σ, ρ, and ω resonances. The most useful form, form A with 31 free parameters, gave a least-squares value $\chi^2 = 1575$ for a fit to data and matrices representing 1147 individual data from 23 to 736 MeV. Several different methods of including the inelastic scattering effects were studied. Although the inelastic scattering has an important effect on the elastic phases, an analysis of the elastic scattering data gives little information about the inelastic phases. A single-energy analysis at 425 MeV where inelastic effects are very small, gave a well-defined result. However, a similar analysis at 630 MeV, where the total inelastic cross section is almost as large as the total elastic cross section, gave only qualitatively correct values for S, P, and D phases, and gave little information about the F and higher phases. The (p,p) elastic scattering matrix can now be defined accurately at energies from 0 to 450 MeV, but at energies above 450 MeV more experimental and theoretical information is still needed before a reliable analysis can be carried out. (auth)

35015 HIGH ENERGY NN SCATTERING WITH LARGE MOMENTUM TRANSFER AND CHIRAL SU(2) X SU(2) SYMMETRY. Hara, Yasuo (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 1020-4(Apr. 1968).

Relations among high energy, large momentum transfer nucleon-nucleon scattering amplitudes are obtained by making use of the assumption that they are chiral SU(2) × SU(2) symmetric. By applying the conventional Regge pole model, which has been successful in reproducing small momentum transfer scattering ($|t| < m_N^2$), to large momentum transfer scattering ($s \gg |t| \gtrsim m_N^2$), it is found that $\sigma(pn \to np$; charge exchange$) \ll \sigma(pp \to pp)$ and that the polarization vanishes very rapidly as the energy increases ($O(s^{-2})$). (auth)

35016 ONE-PION-EXCHANGE MODEL AND THE $N^*_{1238} \to p\pi$ DECAY, PRODUCED IN $pp \to nN^*_{1238}$ BETWEEN 2.8 AND 10 GeV/c. Haber, B.; Yekutieli, G. (Weizmann Inst. of Science, Rehovoth, Isreal). Nuovo Cim., 55A: 667-70(June 21, 1968).

The density matrix elements of the $N^*_{1238} \to p\pi^+$ decay produced in the reaction $pp \to nN^*$ are calculated according to the one-pion-exchange model and compared with experimental results in the (3 to 10) GeV/c momentum range. (auth)

35017 OPTICAL MODEL OF HIGH-ENERGY PROTON-PROTON AND PROTON–ANTIPROTON SCATTERING. Saifuddin (McGill Univ., Montreal. Univ. of Islamabad, Rawalpindi, Pakistan). Nuovo Cim., 55A: 690-700(June 21, 1968).

Most of the features of high-energy (>10 GeV) p-p and p-$\bar{p}$ scattering data are explained by using an optical potential. The potential consists of a Gaussian for the absorption and a Gaussian for the "soft" core. The simple Yukawa forms do not fit the data. The eikonal or high-energy approximation is found inadequate for large-angle scattering due to complex potentials. A fit is obtained up to the momentum transfer of $-t = 6$ (GeV/c)^2 for proton-proton scattering. The available data up to $-t = 0.6$ (GeV/c)^2 for p-$\bar{p}$ scattering for incident momenta of 12 and 16 GeV/c are also fitted. (auth)

35018 THE $\Lambda-\Lambda$ HYPERNUCLEI $^{14}C_{\Lambda\Lambda}$ AND $^{18}O_{\Lambda\Lambda}$. Ananthanarayanan, K. (Stanford Univ., Calif.). Nuovo Cim., 55B: 419-26 (June 11, 1968).

The binding energies of the $\Lambda-\Lambda$ in $^{14}C_{\Lambda\Lambda}$ and $^{18}O_{\Lambda\Lambda}$ are estimated using the model of Dawson, Talmi and Walecka taking for the $\Lambda-\Lambda$ interaction the potential derived from $^6He_{\Lambda\Lambda}$. The modifications of the binding energies correcting errors due to the uncertainties in the potential derived from $^6He_{\Lambda\Lambda}$ are also discussed. (auth)

35019 IMPULSE–MODEL CALCULATIONS OF THE Σ-HYPERON CONVERSION PROCESS IN LIGHT NUCLEI. Kenyon, I. R. (Brookhaven National Lab., Upton, N. Y.). Nuovo Cim., 55B: 371-403(June 11, 1968). (BNL-11893).

Impulse model calculations of the Σ-hyperon conversion process for the reactions $\Sigma^- + {}^4He \to \Lambda^0 + n + t$ and $K^- + {}^4He \to (E + \text{nucleus}) + \pi^- \to \Lambda^0 + p + d + \pi^-$ at rest are described in detail. By introducing an effective nuclear potential acting on the Σ-hyperon before conversion, one is able to obtain good fits to the experimental momentum spectrum of the outgoing baryonic particles. The potentials required in the two reactions are shown to be consistent with each other and with other available data for heavier nuclei. Previously Cohn et al. (Phys. Rev. Lett., 13, 668 (1964)), studying the reaction $\Sigma^- + {}^4He \to \Lambda + n + t$ had observed a marked disagreement between the experimental triton momentum distribution and the impulse prediction when no nuclear potential was used. Their interpretation of this effect as due to the formation of a Y = 1 dibaryon resonance in the final state appears to be invalid. (auth)

35020 PROBLEMS OF πd SCATTERING. Dal'karov, O. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern, Fiz., 7: 820-2(Apr. 1968). (In Russian).

For initial kinetic energy of π mesons $T_\pi \approx 200$ MeV the contribution of the square diagram with the virtual isobar Δ_{33} to the amplitude of the πd elastic scattering is calculated. A good agreement between experimental and theoretical curves is obtained. (auth)

35021 FORMULAS FOR SIMULTANEOUS RELATIVISTIC PHASE-SHIFT ANALYSIS OF THE ELASTIC AND THE INELASTIC NUCLEON–NUCLEON SCATTERING. Bogoslovskii, G. Yu.; Klepikov, N. P. (Moscow State Univ.). Yadern. Fiz., 7: 899-908(Apr. 1968). (In Russian).

Formulas for simultaneous analysis of the reactions $N + N \to N + N$, $N + N \to \pi + d$ and $N + N \to \pi + N + N$ are given. (auth)

35022 SHORT-WAVE REPULSION IN NN SCATTERING. Lend'el, V. I.; Serebryakov, V. V. (Inst. of Mathematics and Computer Center, Novosibirsk, USSR). Yadern. Fiz., 7: 879-83 (Apr. 1968). (In Russian).

It is shown that the introduction of the universal short-wave repulsion does not contradict the NN scattering experimental data. However, its definite determination depends on the detail form of a contribution from the potential with I = J = 0. (auth)

35023 ON "CONSPIRACY" OF SINGULARITIES IN THE j PLANE. Kaidalov, A. B.; Karnakov, B. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 884-9 (Apr. 1968). (In Russian).

Relations between positions on the Regge poles at t = 0, obtained by Volkov and Gribov for the NN scattering, are generalized to the case of arbitrary spins of interacting particles. It is shown that for higher spins the relations arise that are most naturally interpreted in terms of the singularities without definite parity The possibility of experimentally investigating the role of such singularities at low t ($|t| \ll \mu^2$) is discussed. (auth)

35024 SINGLE REGGE-POLE FIT TO 90^0 p–p SCATTERING. Sakmar, I. A. (Univ. of Western Ontario, London); Wojtaszek, J. H. Nuovo Cim., 56A: 92-6(July 1, 1968).

It is shown that the Pomeranchuk pole alone can explain the break observed in 90° elastic proton-proton scattering differential cross section if a reasonable trajectory is chosen and Legendre functions are used rather than their asymptotic expansions. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 35237.

35025 REALIZATION OF LIE ALGEBRAS BY ANALYTIC FUNCTIONS OF GENERATORS OF A GIVEN LIE ALGEBRA. Chand, P; Mehta, C. L.; Mukunda, N.; Sudarshan, E. C. G. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 8: 2048-59(Oct. 1967).

The problem of the Poisson bracket realization of various Lie algebras is discussed in terms of analytic functions of the generators of a given Lie algebra. The problem of realizing the general 0(4), 0(3, 1), and E(3) algebras in terms of analytic functions of the generators of a prescribed realization of an E(3) algebra is posed and solved. A similar problem is solved for the symmetric tensor realizations of SU(3) and SL(3, R). Related questions are discussed for O(n + 1), O(n, 1), E(n), SU(n), and SL(n, R). The finite canonical transformations realized by the generators of the various groups are studied in some detail. The relation of these results to the reconstruction problem is briefly discussed. (auth)

35026 UNITARY IRREDUCIBLE REPRESENTATIONS OF SU(2,2). I. Yao, Tsu (Rutgers-The State Univ., New Brunswick, N. J.). J. Math. Phys. (N. Y.), 8: 1931-54(Oct. 1967).

The general properties of the noncompact group SU(2, 2), the Lie algebra of which is isomorphic to the Dirac algebra are considered. In the course of this study of the unitary representations, all the finite-dimensional irreducible representations were first obtained. The associated Young diagrams are shown to have simple properties; the degenerate Young diagrams always denote degenerate representations. Through a theorem of Harish–Chandra, which relates the finite representations to the unitary representations in the discrete series, one is able to obtain explicitly all the unitary infinite-dimensional irreducible representations in this series, both degenerate and nondegenerate. The notion of multiplicity for nondegenerate representations is introduced and discussed in connection with a new operator F_3, which is required for a complete labeling of states. (auth)

35027 DIRAC ALGEBRA AND THE SIX-DIMENSIONAL LORENTZ GROUP. ten Kate, A. (Univ. of Nijmergen, Netherlands). J. Math. Phys. (N. Y.), 9: 181-5(Feb. 1968).

The relation between the Dirac algebra and the six-dimensional Lorentz group is established. By considering in an appropriate way the fifteen eccentrical basis elements of the Dirac algebra as the components of an antisymmetrical tensor in six dimensions, the commutation as well as the anticommutation rules of the algebra can be written in a six-covariant way. The group of automorphisms of the real Dirac algebra turns out to be isomorphic to the proper six-dimensional Lorentz group. However, this result is very sensitive to the specific choice of Lorentz metric. (auth)

35028 GROUP OF TIMELIKE PERMUTATIONS. Barucchi, G. (Univ., Turin). Nuovo Cim., 55A: 385-95(June 1, 1968).

The group of timelike permutations on R^{n+1}, T_{n+1}, the group of spacelike permutations on R^{n+1}, S_{n+1}, and the group of lightlike permutations on R^{n+1}, L_{n+1}, $(n \geq 1)$, are defined, where R^{n+1} is the Cartesian product $R^{n+1} = R_{x_0} \times R_{x_1} \times \dots \times R_{x_n}$ and R_{x_i}, $(i = 0, 1, \dots, n)$, is the set of all real numbers. A permutation on the set R^{n+1} is a timelike permutation $t_{n+1} \in T_{n+1}$, $(n \geq 1)$, if both t_{n+1} and $(t_{n+1})^{-1}$ preserve the relation T. x, y being two points whatsoever belonging to R^{n+1}, xTy means $Q(x - y) > 0$, where $Q(z) = z_0^2 - z_1^2 - \dots - z_n^2$, $z = (z_0, Z1, \dots, z_n) \in R^{n+1}$, $(n \geq 1)$. The spacelike permutations $s_{n+1} \in S_{n+1}$ and the lightlike permutations $l_{n+1} \in L_{n+1}$, $(n \geq 1)$, are defined in a similar way by using the respective conditions $Q(x - y) < 0$ and $Q(x - y) = 0$, $x \neq y$. It is proved that $T_{n+1} = S_{n+1} = L_{n+1} = D_{n+1}$, $(n > 1)$, where D_{n+1}, $(n \geq 1)$, is the group whose elements are all and only the transformations on R^{n+1} which are obtained by composing an element of the Poincaré group, P_{n+1}, with an element of the group of the positive dilatations, R_+^1. To prove said theorem the relation $T_{n+1} = S_{n+1}$, $(n \geq 1)$, previously proved, and the property $t_{n+1} \in T_{n+1} \Rightarrow t_{n+1} \in L_{n+1}$, $(n \geq 1)$ are used. The case $n = 1$ is then studied and it is deduced that $T_2 = S_2$ is a proper subgroup of L_2. Finally the group $T_2 = S_2$ and L_2 are studied in detail. (auth)

35029 INTERNAL SYMMETRY AND THE C, P, T OPERATIONS. Roman, P.; Yun, S. K. (Boston Univ.). Nuovo Cim., 55A: 489-500(June 1, 1968).

A proposal is made to realize Lee's scheme of conflicting discrete symmetry operations by assuming that the relevant operators consist of a part acting in ordinary space and a part acting in the internal SU_3 symmetry space. A consistent realization of the internal operators is derived in the octet representation. An interpretation of the mismatches is given. (auth)

35030 A GENERAL STUDY OF THE WIGNER COEFFICIENTS OF SU(1,1). Holman III, Wayne J. (Univ. of Miami, Coral Gables); Biedenharn, Lawrence C. Jr. Ann. Phys. (N. Y.), 47: 205-31(1968).

The Wigner coefficients which couple any two irreducible unitary representations of the noncompact group SU(1,1) are derived by means of the second-order difference equation which defines them. It is found that whenever at least one of the three representations being coupled is discrete, then the two solutions are degenerate, but two linearly independent nontrivial solutions exist, in general, when all three representations are continuous. For this case two orthonormal solutions are found. Some elementary symmetries of the solutions are examined. The integral over the group manifold is regularized by means of a convergence factor in order to make all the irreducible unitary representation functions (the Bargmann functions) mutually orthonormal. This regularization is used for the investigation of the resolvent of the Laplace-Beltrami operator in the space of the Bargmann functions. (auth)

35031 ON THE CONSTRUCTION OF WEIGHT DIAGRAMS FOR SO(5), Sp(4), AND G_2. Gruber, B.; Weber, H. J. (Duke Univ., Durham, N. C.). Proc. Roy. Irish Acad., Sect. A, 66: 31-40(1968).

Relations between multiplicities of weights of rank two groups are obtained. From these relations a simple method is obtained which allows easy construction of the weight diagrams of B_2 (SO(5)), C_2 (Sp(4)) and G_2 from the weight diagrams of SU(3). For SU(3) it is moreover shown how the multiplicity of a weight can be brought into relation with dimensions of SU(2) representations. (auth)

35032 SL(2,C) IN AN INFINITE-MOMENTUM E(2) BASIS AND THE CALCULATION OF FORM FACTORS. Chang, Shau-jin; Kuriyan, Jacob G.; O'Raifeartaigh, L. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 169: 1275-7(May 25, 1968).

In the infinite-momentum limit the E(2) subgroup of the homogeneous Lorentz group SL(2,C) becomes meaningful. It is shown that this decomposition of SL(2,C) in an E(2) basis is also useful in calculations of form factors involving the SL(2,C) group. In particular, the Barut-Kleinert and Nambu form factors are derived in a straightforward fashion. (auth)

35033 INFINITE MOMENTUM, EQUIVALENCE CONDITION, AND SPECTRAL-FUNCTION SUM RULES. Lu, Eugene Y. C. (Ohio State Univ., Columbus). Phys. Rev., 169: 1308-14(May 25, 1968). (COO-1545-33).

A derivation of the SU(3) × SU(3) spectral-function sum rules based on sum rules derived by Taha using the infinite-momentum technique and the assumption of partially conserved axial-vector current is presented. The off-shell nature of the second-spectral-function sum rules is pointed out and its consequences are discussed. The necessary conditions for Taha's infinite-momentum sum rules to converge, and hence also for the spectral-function sum rules, are obtained and discussed on the basis of the equivalence condition of Taha. Comments are made on the other derivations of the spectral-function sum rules. (auth)

35034 LECONS SUR LA THEORIE DES GROUPES ET LES SYMETRIES DES PARTICULES ELEMENTAIRES. (Lessons on Group Theory and Elementary Particle Symmetries). Bacry, H. Cours et Documents de Mathematiques et de Physique. New York, Gordon and Breach Science Publishers, 1967. 465p. $22.00 Hardbound; $17.00 Paperbound.

The discussion of group theory and elementary particle symmetries covers the elements of group theory, vectorial space, representations, finite representations of the linear groups GL(n,C) and their principle subgroups, generalities of Lie groups, and the group of rotations SO(3). Also discussed are the Lorentz group, the Poincaré group, elementary particle symmetries, and unitary symmetry and its generalizations. (J.F.P.)

35035 ON THE PRIMITIVE CHARACTERS OF THE POINCARE GROUP. Joos, H.; Schrader, R. (Deutsches Elektronen Synchrotron, Hamburg). Commun. Math. Phys., 7: 21-50(1968).

The traces of the different types of irreducible representations of the Poincaré group are calculated. These have the form of generalized class functions and their mathematical structure follows from a generalization to noncompact groups of Frobenius' construction of induced characters. (auth)

35036 STATE LABELING OF THE IRREDUCIBLE REPRESENTATIONS OF SU_n. Devi, V. Syamala; Prasad, L. S. R. K. (Andhra Univ., Waltair, India). J. Math. Phys. (N. Y.), 9: 384-5 (Mar. 1968).

State labeling of the irreducible representations of SU_3 is done by using Littlewood's rules for the analysis of products of representations of unitary groups. The method is generalized to any SU_n. (auth)

35037 UNITARY REPRESENTATIONS OF THE LORENTZ GROUPS: REDUCTION OF THE SUPPLEMENTARY SERIES UNDER A NONCOMPACT SUBGROUP. Mukunda, N. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 9: 417-31(Mar. 1968).

Unitary representations of O(2,1) belonging to the exceptional class are reduced with respect to the noncompact subgroup O(1,1). The result that the spectrum of the generator of this subgroup covers the real line twice. Unitary representations of O(3,1) belonging to the supplementary series are reduced with respect to the noncompact subgroup O(2,1). These representations of O(3,1) may be labeled by a parameter ρ in the range $0 < \rho < 1$. Representations corresponding to $0 < \rho \leq 1/2$ yield upon reduction only those representations of O(2,1) that belong to the continuous nonexceptional class; each of these appears twice. A representation corresponding to $1/2 < \rho < 1$, however, yields upon reduction a single representation of O(2,1) of the exceptional class (with parameter $\sigma = \rho - 1/2$) and, in addition, all the representations of O(2,1) of the nonexceptional continuous class. The exceptional representation appears only once, while the nonexceptional ones appear twice each. (auth)

35038 RELATIONSHIPS AMONG THE WIGNER 9j SYMBOLS. Jang, S. (Centre de Recherches Nucleares, Strasbourg). J. Math. Phys. (N. Y.), 9: 397-402(Mar. 1968).

Several identities satisfied by the 9j symbols or by the product of 6j and 9j symbols are derived by means of the symmetry properties of the Möbius strip type 15j symbol. The resulting recursion relations for the 9j symbols are also considered. (auth)

35039 MATRIX ELEMENTS OF REPRESENTATIONS OF NON-COMPACT GROUPS IN A CONTINUOUS BASIS. Barut, A. O.; Phillips, E. C. (Univ. of Colorado, Boulder). Commun. Math. Phys., 8: 52-65(1968).

Explicit formulas are obtained by a simple algebraic method for the representations of the finite group transformations of O(2,1) in a continuous basis when a noncompact generator is diagonalized. Compact and noncompact cases are treated in a unified form and the nature of analytic continuation is determined. The transformation function between the discrete and the continuous bases is also given. These explicit formulas have not been obtained before. (auth)

35040 A CLASSIFICATION OF THE UNITARY IRREDUCIBLE REPRESENTATIONS OF $SO_0(N,1)$. Ottoson, Ulf (Inst. of Theoretical Physics, Goteborg). Commun. Math. Phys., 228-44(1968).

All inequivalent continuous unitary irreducible representations of the group $SO_0(N,1)$, $N \geqq 3$, and its universal covering group are classified. (auth)

35041 MASTER ANALYTIC REPRESENTATIONS AND UNIFIED REPRESENTATION THEORY OF CERTAIN ORTHOGONAL AND PSEUDO-ORTHOGONAL GROUPS. Kuriyan, Jacob G. (Inst. for Advanced Study, Princeton, N. J.); Mukunda, N.; Sudarshan, E. C. G. Commun. Math. Phys., 8: 204-27(1968).

The representation theory of the groups SO(5), SO(4,1), SO(6) and SO(5,1) is studied using the method of master analytic representations (MAR). It is shown that a single analytic expression for the matrix elements of the generators of SO(n + 1) and SO(n,1) in an SO(n) basis yields all the unitary representations (for n = 4, 5); and that the compact and non-compact groups have essentially the same analytic representation. Once the MAR of a group is worked out, the search for the unitary irreducible representations is reduced to a purely arithmetic operation. (auth)

35042 IRREDUCIBLE REPRESENTATIONS OF U_n AND $U_{p,n-p}$. Duimio, F. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cim., 55A: 750-64(June 21, 1968).

A rather simple technique is presented for the construction of the Hermitian irreducible representations of the Lie algebra of the groups U_n. The same technique is applied to the construction of Hermitian irreducible representations of the Lie algebra of the groups $U_{p,n-p}$, belonging to the discrete series. (auth)

35043 COMPLETELY IRREDUCIBLE REPRESENTATIONS OF SU(2,1). Shtern, A. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 179: 1289-92(Apr. 21, 1968). (In Russian).

Assuming that G is a substantive semisimple Lie group and G = UAN is its Ivasava decomposition, M is the centralizer of A and G, the representations of the G group induced by finite, irreducible representations MN were examined while N tends toward unity, examining the structure of these representations for the G = SU(2,1) group of complex unimodulated third-order matrices which conserve their indefinite hermitian form. On the basis of these calculations, the conditions of equivalence and unitary representation were derived. The continuous series of unitary representations in Lie algebra were studied. (TTT)

35044 REMARK ON REPRESENTATIONS OF THE ALGEBRA OF CURRENTS AT INFINITE MOMENTUM. Lipshutz, N. R.; Straumann, N. (Duke Univ., Durham, N. C.). Nuovo Cim., 55A: 834-7(June 21, 1968).

A covariant procedure was recently proposed for constructing representations of the current algebra of infinite momentum. The approach consisted essentially in finding an infinite set of c-number spinors which transform according to an infinite-dimensional representation of $SL_{2,c}$ and satisfy a completeness relation for fixed three-momentum. The question is studied of whether a completeness relation in the infinite momentum frame for a set of covariant c-number spinors with positive timelike moments implies a degenerate mass spectrum. (L.B.S.)

35045 ELEMENTARY PARTICLES. Gell-Mann, Murray (Inst. for Advanced Study, Princeton, N. J.). J. Franklin Inst., 284: 341-3(Dec. 1967).

The eight-fold way for the cataloging of elementary particles is discussed. In particular, attention is paid to the origins of the description and of the nature of physical laws. The original conception of the idea is noted against Gell-Mann's pragmatic approach to physical problems, as opposed to those approaches which are very firmly established within the conceptual scheme of an existing mathematical or philosophical system. The inviolability of physical laws is discussed, in particular when existing formulation of laws leads to paradoxes. Development of physical principles is an evolutionary process, and some of the stages of elementary particle description are noted; it is suggested that astrophysical phenomena should be approached by the same route. Further details of the nature of elementary particles, and their symmetrical description by early approaches, conclude the discussion. (BBB)

35046 RELATIVISTIC SPIN EQUATION AND ITS GENERALIZATION. Hwa, R. C. (State Univ. of New York, Stony Brook). Nuovo Cim., 56A: 107-26(July 1, 1968).

A relativistic wave equation for any spin is formulated by building up the second Casimir operator, $w^\mu w_\mu$, of the Poincaré group in an irreducible representation of $L \otimes P_0$, where L is the spin part of the homogeneous Lorentz group and P_0 the orbital Poincaré group. The wave equation in momentum space has the form $[\Gamma^{\mu\nu}p_\mu p_\nu - (a + bp^2 + cp^4 + \ldots)]\ \varphi(p) = 0$, where $\Gamma^{\mu\nu}$ are matrices of infinite or finite dimensions according as the irreducible representation of L is unitary or not. Depending upon the values of the constants, a, b, c, ..., the equation may require solutions with unique spin or with definite mass-spin constraint. Explicit representations of $\Gamma^{\mu\nu}$ are evaluated, and solutions to some simple problems are given as illustrations. (auth)

35047 REDUCED WAVE EQUATION WITH INFINITE COMPONENTS. Hwa, R. C. (State Univ. of New York, Stony Brook). Nuovo Cim., 56A: 127-43(July 1, 1968).

Wave equations of the type $[\Gamma^\mu p_\mu - c(p^2)]\ \psi(p) = 0$ are considered which is the reduced form of the higher-order wave equation constructed earlier on the basis of the Casimir operator $w^\mu w_\mu$ of the Poincaré group. By the reduced form is meant the same kind of relationship that the Dirac equation has to the Klein-Gordon equation. Covariance under the homogeneous Lorentz group including inversion leads to the consideration of infinite-dimensional representations for the reduced wave equation. Two different representations of Γ^μ are investigated in detail, one suitable for integral spins, the other for half-odd integral spins. Matrix elements of Γ^μ are given explicitly. Some general properties of the wave equation are discussed. As a by-product of this investigation, the conditions are found under which Γ^μ together with $S^{\mu\nu}$, the spin part of the generators of the Lorentz group, form the generators of the de Sitter group. The reduced equation does not have this property; the mass spectrum for an equation that does is discussed. (auth)

35048 A NOTE ON THE ADDITIONAL GENERATORS OF THE $O_{4,1}$ GROUP OF THE HYDROGEN ATOM. Swamy, N. V. V. J. (Oklahoma State Univ., Stillwater); Sheth, C. V. Nuovo Cim., 56A: 29-32(July 1, 1968).

Several papers have recently appeared on the noninvariance group $O_{4,1}$ pertaining to the bound states of the nonrelativistic hydrogen atom. In the additional scalar and vector generators of this noncompact group an operator N has been used whose eigenvalue is N, the so-called principal quantum number. It is pointed out in this paper that, in order to get an explicit representation of N other than the assumed square root of an appropriate function of the Schroedinger Hamiltonian, it may be necessary to go to the larger group $SU_2 \times O_4$. An operator exists which, when iterated, gives the nonrelativistic Hamiltonian. This operator possesses exact eigenfunctions and eigenvalues which are functions of N. (auth)

35049 EXPLICIT COMPUTATION OF THE SU_3 CLEBSCH-GORDAN COEFFICIENTS. Chew, C.-K. (Laval Univ., Quebec); von Baeyer, H. C. Nuovo Cim., 56A: 53-63(July 1, 1968).

The general SU_3 CG coefficient in the $SU_3 \supset SU_2$ scheme is explicitly computed by using an efficient Fortran program. Isoscalar factors for two cases in the octet scheme are tabulated. (auth)

Applications (Electromagnetic and Weak)

35050 (JINR-P2-3743) NARUSHENIE CP-INVARIANTNOSTI V SLABYKH RADIATSIONNYKH RASPADAKH. (CP Non-Invariance in Weak Radiative Decays). Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 23p. (In Russian). Dep.

Results of the CP and T noninvariance in various interactions indicate that only a limited number of interaction mechanisms, such as the "ministrong" hadron interaction, the "miniweak" lepton interaction, may be used as a theoretical model and experimental study method. The potential existence of the weak electromagnetic interaction is of great interest. No general principles have as yet been developed to allow a reasonable choice between the various mechanisms. In some cases, weak radiation processes may yield information also about miniweak processes; this is illustrated by specific examples. In view of the scarcity of information about weak radiative processes, in the study of the CP noninvariance, attention was focused on phenomenological analysis. Disturbances in CP and T invariance in weak radiative processes may be due to forbidden decays, charge asymmetry, forbidden peaks, conservation-forbidden CP interference in the decay of neutral K mesons, destruction of the equilibrium, electric dipole moments of electrons, neutrons and muons, etc. (Review article, 22 references). (TTT)

35051 (NP–17486) BOSON 27-PLET IN THE UNITARY SYMMETRY MODEL. Gastmans, R.; Halzen, F. (Louvain Univ. (Belgium). Inst. for Theoretical Physics). [1967]. 17p. Dep.

The mass formulas and decay rates of a 27-plet of bosons in the unitary symmetry model are investigated. The specific example considered is the $I = 2\rho^{-}\pi^{-}$ resonance at 1320 MeV. Identification of particle states and tensors in a 27-plet, mass relations for a 27 irreducible representation, the Martin effective threshold method, the TVP vertex in the octet dominance approximation, mass relations for a reducible 1 + 8 + 27 representation, and the 405 as a candidate for meson resonances are discussed. (J.F.P.)

35052 LIFETIME OF THE KAPPA MESON. Hertel, Peter (Univ., Heidelberg). Z. Phys., 211: 491-4(1968).

The lifetime of a hypothetical κ meson with low mass, introduced by GLASHOW and WEINBERG in a model for simultaneous breaking of SU(3) and chiral symmetry, is calculated. The coupling constant of the κ to $K\pi$ is obtained by assuming that the divergence of the strangeness changing vector current is dominated by the κ pole. (auth)

35053 CP NONINVARIANCE IN THE THREE-TRIPLET MODEL. Woo, C. H. (Univ. of Maryland, College Park). Phys. Rev., 169: 1179-81(May 25, 1968).

The behavior of weak currents in the Han-Nambu model is considered. Under certain assumptions about symmetry breaking, it is possible to introduce a "maximal" CP violation, which nonetheless gives rise to CP-nonconserving effects only of the order $\lesssim e^{2}G_{weak}$ in most processes. (auth)

35054 PARITY-VIOLATING HYPERON DECAYS IN SU(3). Taha, M. O. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 169: 1182-5(May 25, 1968).

It is shown that any SU(3) model with (i) CP invariance, (ii) the weak current in an octet, and (iii) vanishing decuplet contributions, reproduces the experimental results on the parity-violating hyperon decays in terms of one parameter. Beyond the $\Delta I = 1/2$ restrictions, such a model gives three relations among the remaining four independent observable amplitudes, which are well satisfied experimentally. (auth)

35055 RECENT ρ-PRODUCTION EXPERIMENTS AND THE PREDICTIONS OF CHIRAL SYMMETRY. Geffen, D. A.; Walsh, T. (Univ. of Minnesota, Minneapolis). Phys. Rev. Lett., 20: 1536-8 (June 24, 1968).

It is shown that the recent electron-positron colliding-beam experiment at Novosibirsk and ρ-photoproduction experiment at Deutsches Elektronen-Synchrotron yield ρ couplings which are consistent with the predictions of simple $SU(2) \otimes SU(2)$ effective Lagrangian theories containing an axial-vector meson. This includes the prediction of the virtual ρ mass dependence of $\gamma_{\rho\pi\pi}$. (auth)

35056 THEORY OF CP NONCONSERVATION. Oakes, R. J. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett., 20: 1539-42(June 24, 1968).

A new current × current weak interaction is constructed from the neutral vector and axial-vector currents which preserves the hypothesis of conserved vector current, universality, lepton conservation, and CPT invariance, but violates CP conservation. The complete weak interaction Hamiltonian is shown to be in agreement with present experiments. (auth)

35057 SPECTRAL-FUNCTION SUM RULES AND THE σ-TERM. Guralnik, G. S.; Kang, K. (Brown Univ., Providence). Nuovo Cim., 55A: 850-2(June 21, 1968). (NYO-2262TA-179).

It is emphasized that in the case of chiral $SU(2) \times SU(2)$ the Weinberg second sum rule is not expected to be valid in hard-pion calculations. (L.B.S.)

35058 ELECTROPRODUCTION OF HIGHER BARYONIC RESONANCES AND THE SU(6)W SYMMETRY. Volkov, D. V.; Lazarenko, L. A. Yadern. Fiz., 7: 843-8(Apr. 1968). (In Russian).

Electro-excitation of baryonic resonances belonging to two main Regge trajectories with the quantum numbers of decuplet and octet is considered assuming these resonances to belong to the ladder representation of the U(6,6) group. For the decuplet Regge trajectory the group in question results in the presence of transitions of the magnetic type only. For the octet Regge trajectories, two-relations between six form factors are obtained which describe the nucleon electro-excitation in a state with the spin $J \geq 5/2$ in general. The assumption that the vector meson exchange prevails in the electromagnetic form factors allows one to obtain two other relations between the form factors. Experimental check of the first relation is the most simple. (auth)

Applications (Strong)

35059 DEVIATION FROM SU_3 SYMMETRY OF VPP COUPLING CONSTANTS IN A FIELD THEORY OF VECTOR MESONS. Akiba, T. (Brown Univ., Providence). Contract AT(30-1)-2262. Nuovo Cim., 55A: 170-80(May 1, 1968). (NYO-2262TA-167).

The SU_3 breaking in the effective coupling constants for a vector meson decaying into two ps mesons is discussed from the point of view of a Lagrangian field theory of vector mesons, essentially based on the Ward identity and the Johnson sum rule. With reasonable approximations, the results of current algebra or of sum rules for the spectral functions of SU_3 symmetry are reproduced, although the dynamical assumption on the symmetry breaking is not the same. (auth)

35060 CURRENT ALGEBRA AND PARTIAL SYMMETRY. I. $(SU_4)_W$. Englert, F.; Brout, R. (Univ. Libre, Brussels). Nuovo Cim., 55A: 543-57(June 1, 1968).

The algebra of the good operators of Fubini is studied. The commutators of the positive-parity currents define the W-spin algebra and are saturated with a finite set of states for both baryons and mesons, a procedure which is shown to be correct to $O[(m_{\Delta}-m_{N})/\overline{m}]^{2}$. Schwinger's phenomenological coupling of ρ, π to nucleons is thereby recovered. The negative-parity currents are subjected to a generalized partial-conservation hypothesis (PCAC for the axial current and a generalized PCTC for the negative-parity tensor currents). The algebra implies that the divergences of these currents are coupled to the mesons through the single constant f_{π} which appears in the conventional PCAC, despite the mass differences for the mesons. The value of f_{π} is determined by the algebra of the negative-parity currents through the Kawarabayashi-Suzuki relation. Schwinger's estimate $F_{A} = \frac{5}{3}\sqrt{2}$ is recovered in the manner of Freund. Schwinger's estimate for the isovector part of the magnetic moments is also recovered. However the isoscalar part must be modified. (auth)

35061 MISSING SU(3) MULTIPLETS AND SU(6,6) SELECTION RULES. Abramsky, J.; King, R. C. (Univ. of Southampton, Eng.). Phys. Rev. Lett., 20: 1408-10(June 10, 1968).

Production processes and SU(6,6) selection rules for high-dimensional SU(3) multiplets such as 10^{*}, 27, and 35 are studied in detail. (L.B.S.)

35062 RELATIONS BETWEEN THE SPECTRA OF 2^{+} AND 2^{-} MESONS. Itoh, Chiaki (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 1072-3(Apr. 1968).

The existence of an $I = 1$, $J^{PG} = 2^{\mp}$ meson, called A_{25}, with the same mass as the A_2 ($J^{PG} = 2^{\pm}$) is examined within exact chiral $SU(2) \times SU(2)$ symmetry. Relations are obtained between the spectral functions of the symmetric tensor current and the symmetric axial-tensor current, which couple to the 2^{+} and 2^{-} meson, respectively. (L.B.S.)

35063 POSSIBLE 27-PLETS IN BARYON RESONANCES. Oyanagi, Yoshio (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 39: 1073-6(Apr. 1968).

The possible existence of 27-plots in baryon resonances is studied on an experimental basis, using data compiled by Rosenfeld et al., of internal quantum numbers, masses, and partial decay rates. From the analysis of presently known resonances, it is concluded that there remain two candidates for 27-dimensional multiplets of SU(3), one in $3/2^{-}$ and one in $1/2^{-}$ (L.B.S.)

35064 SYMMETRIES AND ELEMENTARY PARTICLES. Low, Francis E. Documents on Modern Physics. New York, Gordon and Breach Science Publishers, Inc., 1967. 111p. $7.00.

Lectures are presented on the symmetry principles which hold for the strong interactions. The spectrum of the particles is also discussed under this heading, and the symmetry principles are applied to give an overall phenomenological picture of the strong interactions. The following symmetries are discussed in detail: space inversion (P), charge conjugation (C), time reversal (T), PCT, isotopic spin (I), G-parity, and SU(3). (L.B.S.)

35065 FORWARD AND BACKWARD BARYON–BARYON SCATTERING IN A $S(U(3) \times U(3))$. Ruegg, H.; Oberholzer, J. (Univ., Geneva). Helv. Phys. Acta, 41: 282-6(May 15, 1968). (In French).

Predictions due to the symmetry $S(U(3) \otimes U(3))$ applied to collinear (backward and forward) scattering of two octets of spin-$1/2$ baryons are given. This group is the smallest one which combines SU(3) and spin and which commutes with the Lorentz-transformations along a given direction. The model distinguishes between the different polarizations of the particles and the experimental test of the relations established implies the need for polarized beams and targets. (auth)

35066 SUM-RULE CALCULATIONS BY CURRENT COMMUTATORS IN BROKEN SU_3. Bose, S. K. (Indian Inst. of Tech., Kanpur). Nuovo Cim., 55A: 844-6(June 21, 1968).

Current commutators in broken SU_3 are used to find a mass formula for vector mesons by incorporating $\varphi-\omega$ mixing and the sum rules in baryon–baryon–vector-meson strong-interaction coupling constants. (L.B.S.)

35067 PROBLEM OF CLASSIFICATION OF MESONIC RESONANCES IN THE SCHEME 405. Stroganov, Yu. G. Yadern. Fiz., 7: 909-12(Apr. 1968). (In Russian).

Based on the SU(6) group 405-representation, the classification of mesonic resonances is considered. It is shown that the 405-plet describes experimentally observed resonances reasonably. Partial widths of the resonances with $J^P = 2^+$ are estimated. (auth)

Field Theories

General

35068 SPREADING OF FIELD CLUSTERS IN CLASSICAL FIELD THEORY. Turikov, V. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 1, 47-52(Jan.-Feb. 1968). (In Russian).

The solutions of the Klein–Gordon and Prok equations were examined in the form of clusters. Under field cluster was understood the classical field, the amplitude of which was localized in the finite limits of space. The concept of the width of the field clusters was introduced and the dependence of this width on time was investigated. (tr-auth)

35069 COVARIANT NOETHER IDENTITIES IN COVARIANT FIELD THEORIES. Ray, J. R. (Clemson Univ., S. C.). Nuovo Cim., 56A: 189-96(July 1, 1968).

In covariant field theories such as general relativity the application of Noether's theorem results in a set of identities which are satisfied regardless of whether the field equations are satisfied or not (so-called strong-conservation laws). In the conventional formulation these identities contain nontensorial quantities and nontensorial operations. Thus, for example, the energy-momentum pseudotensor of general relativity is obtained from such formulations. The identities arising from Noether's theorem are written in an obviously covariant form containing only tensors and covariant derivatives. As an example these identities are given for general relativity. (auth)

Quantum Field Theory

Refer also to abstracts 34902 and 34973.

35070 (JINR–P2-3777) KVANTOVAYA TEORIYA SKALYARNOGO POLYA V PROSTRANSTVE DE SITTERA. (Quantum Theory of Scalar Field in de Sitter Space–Time). Tagirov, E. A.; Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 49p. (In Russian). Dep.

The quantum theory of scalar field is constructed in the de Sitter spherical world. The conserved quantities are obtained which correspond to isometric and conformal transformations. The Fock representations with the cyclic vector, which is invariant under isometries, are shown to form a one-parametric family. They are inequivalent for different values of the parameter. However, its single value is picked out by the requirement for motion to be quasiclassic for large values of square of momentum space. Then the basis vectors of the Fock representation can be interpreted as the states with definite number of particles. (auth)

35071 (LPTHE-TH–68/6) ON THE FUNCTIONAL FORMALISM IN QUANTUM FIELD THEORY. Dubois-Violette, M. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). Mar. 1968. 13p. Dep.

A formalism is developed to deal with c-number generating functionals of quantum field theory. The general unitary relations and Schwinger equations are investigated using this formalism. Then, the formalism is used to construct a functional formulation of quantum field theory, in which state vectors are described by functionals, and field operators by functional differential operators. This formulation is in complete analogy with the wave-mechanics formulation of nonrelativistic quantum theory, in which state vectors are described by functions and observables by differential operators. Finally the case of the electromagnetic field is investigated. This framework leads to a great unification of the functional formalism and simplifies the explicit calculations in many cases. (auth)

35072 (RT/FI–(68)6) DIRAC SPINORS, COVARIANT CURRENTS AND THE LORENTZ GROUP OVER A FINITE FIELD. Beltrametti, E. G.; Blasi, A. A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 22p. Dep.

The pecularities of some physical schemes are explored within a finite geometry. By finite geometry is meant the set of space–time points having coordinates in a finite field GF(k) of order k, i.e., in a set of k marks closed under the four arithmetical operations. A summary of the proper Lorentz and rotation groups over GF(p) is given, and the unitarity problem is considered. The proper group L(4,p) is extended through the improper transformations and the four-dimensional representations, leading to Dirac spinors over a finite field are examined. The properties displayed by bispinor sesqui-linear forms (e.g., the ones occurring in weak interaction Hamiltonians) when covariance is demanded with respect to the finite version of the Lorentz group are treated. (J.F.P.)

35073 STRUCTURE OF THE POINCARE GENERATORS. Fleming, Gordon N. (Pennsylvania State Univ., University Park). J. Math. Phys. (N. Y.), 9: 193-206(Feb. 1968).

The Poincaré generators for an open system augmented by the interaction parts of the full Poincaré generators are shown to satisfy a closed set of coupled differential equations having a form which is independent of the nature of the interaction parts. The differential equations are formulated in the hyperplane formalism, the differentiation being with respect to the hyperplane parameters. The general solutions of the equations are studied, yielding relations among the augmented generators that must be preserved in the limit of zero interaction, i.e., for a closed system. Introducing a hyperplane-dependent Hamiltonian density in a manner not implying local field theory, the obtained relations are shown to yield expressions for all the generators of a closed system in terms of the Hamiltonian density and its derivatives alone. (auth)

35074 UPPER BOUNDS ON HOLOMORPHY ENVELOPES FOR WIGHTMAN FUNCTIONS. Manoharan, A. C. (Univ. of Wisconsin, Milwaukee). J. Math. Phys. (N. Y.), 8: 2026-29(Oct. 1967).

As a consequence of Lorentz invariance, reasonable mass spectrum and local commutativity, the holomorphy envelopes $H(\mathfrak{S}_n^P)$ for the analytic functions arising from vacuum expectation values of products of n field operators are related in such a way that $H(\mathfrak{S}_n^P)$ furnishes upper bounds (in the coordinates) for all $H(\mathfrak{S}_N)$ with $N > n$. (auth)

35075 INTERNAL HOLONOMY GROUPS OF YANG–MILLS FIELDS. Loos, Hendricus G. (Douglas Advanced Research Labs., Huntington Beach, Calif. Univ. of California, Riverside). J. Math. Phys. (N. Y.), 8: 2114-24(Oct. 1967).

Classical Yang–Mills potentials define a Lie group, the internal holonomy group, which is analogous to the ordinary holonomy group defined by the Christoffel symbols in general relativity. The internal holonomy group is an important tool for the dissection and study of the Yang–Mills equations and of local gauge theory in general. A number of theorems on internal holonomy groups is presented, together with some applications. (auth)

35076 ANALYTIC FUNCTIONALS IN QUANTUM FIELD THEORY AND THE REGULARIZATION OF ULTRAVIOLET DIVERGENCES. Thiess, Frank B. (Univ. of California, San Diego). J. Math. Phys. (N. Y.), 9: 305-15(Feb. 1968).

The commutator and propagator distributions associated with free-particle fields are represented as boundary values of analytic kernels in complex space-time. A distribution product of such quantities is then defined as a boundary value of the product of the analytic kernels of its various factors, with the proviso that the product kernel be understood in the sense of Hadamard's "finite part" in those cases when it would otherwise be nonintegrable. For the case of quantum electrodynamics, the momentum-space representation of the products of causal propagators are derived. It is demonstrated by explicit calculation that the second-order scattering matrix elements thus obtained are identical to those usually obtained by means of Pauli–Villars regularization and renormalization. (auth)

35077 2V SECTOR OF THE LEE MODEL. Scarfone, Leonard M. (Univ. of Vermont, Burlington). J. Math. Phys. (N. Y.), 9: 246-54(Feb. 1968).

The Lehmann–Symanzik–Zimmerman (LSZ) formalism is further used to analyze the 2V sector of the Lee model with boson sources at zero separation. Unlike previous LSZ investigations of the model, it is found that the solutions to two singular integral equations solve the entire sector. Two scattering amplitudes, a production amplitude, and an equation for the determination of the 2V potential energy are obtained. Similarities and differences between this sector and the $V + \theta$ subspace are pointed out. (auth)

35078 CHARGE CONJUGATION AND SELF-CONJUGATE BOSONS AND FERMIONS. Weaver, D. L. (Tufts Univ., Medford, Mass.). Nuovo Cim., 55A: 377-84(June 1968).

The two types of charge conjugation seen in nature are discussed for particles with arbitrary integral or half-integral spin using a spinor formulation. The field operators for self-conjugate (neutral) particles are constructed for all spins and their commutation or anti-commutation relations determined. (auth)

35079 NEW FORMULATION OF QUANTUM ELECTRODYNAMICS. Maris, Th. A. J.; Dillenburg, D.; Goncalves da Silva, C. E. T.; Jacob, G.; Liberman, B. (Univ. do Rio Grande do Sul, Porto Alegre, Brazil). Nuovo Cim., 55A: 590-4(June 1, 1968).

A new formulation of quantum electrodynamics is discussed in which the quantum fields are replaced by classical fields. (L.B.S.)

35080 GREEN'S FUNCTION OF BILOCAL FIELD EQUATIONS. Shirafuji, Takeshi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 39: 1047-68(Apr. 1968).

The Green's function of bilocal field equations is investigated; it is decomposed into partial waves of the little group (SO(3), SO(2,1) for the time-like and space-like four momentum). Assuming that the partial wave Green's function can be analytically continued into the l-plane, special attention is given to the role of the Regge pole term. It is found that this term is a homogeneous solution of the field equation and that its existence in the Green's function is required for the space-like part of the Green's function to be connected with the time-like part by analytic continuation. Some model field equations are discussed as examples. A few comments are made on the quantization of the bilocal field and on the vertex among the bilocal fields. (auth)

35081 IMPOSSIBILITY OF FINITE CHARGE RENORMALIZATION IN SIXTH ORDER. Hagen, C. R.; Samuel, M. A. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 20: 1405-7(June 10, 1968).

Making use of a recent result obtained by Jackiw in the context of the renormalization group the question of whether there exists the possibility of obtaining finite charge renormalization by means of an eigenvalue condition on the bare coupling constant is examined. It is shown that to sixth order in e_0 a cancellation of the divergences encountered in perturbation theory cannot occur. (auth)

35082 CONDITIONS FOR COMPOSITE PARTICLES WITH SPECIAL REFERENCE TO LAGRANGIAN FIELD THEORY. Osborn, Hugh (University Coll., London). Ann. Phys. (N. Y.), 47: 308-50(1968).

The question of the vanishing of renormalization constants Z_3 and Z_1 as conditions for compositeness is looked at once more both from the viewpoint of dispersion theory and field theory. Careful consideration is given to the formulation of the idea of a composite particle as one for which there exist no independent parameters within the theory. The theory of a pseudoscalar field coupled to a spinor field is examined in detail and it is shown that $Z_1 \rightarrow 0$ and $Z_3 \rightarrow 0$ give the condition for equivalence to a theory in which the pseudoscalar particle is purely composite. It is unlikely however that these limits provide a ready realization of the conditions for a bootstrap situation. (auth)

35083 ELECTROMAGNETIC MASS SHIFTS, EQUAL-TIME COMMUTATORS, AND JOST-LEHMANN REPRESENTATION. Boulware, David G. (Univ. of Washington, Seattle); Deser, Stanley. Phys. Rev. Lett., 20: 1399-1402(June 10, 1968).

Electromagnetic mass shifts, equal-time commutators (ETC), and their relation are analyzed, using the Jost-Lehmann representation for the forward Compton amplitude. The divergences in δm are determined by Lorentz scalars associated with the ETC (when these exist). These results are illustrated by models with currents bilinear and linear in canonical fields. Existence of the ETC implies that the Jost-Lehmann representation is unsubtracted. (auth)

35084 VALIDITY OF SPECIAL RELATIVITY AT SMALL DISTANCES AND THE VELOCITY DEPENDENCE OF THE CHARGED-PION LIFETIME. Lundberg, L.-E.; Redei, L. B. (Umea Univ., Sweden). Phys. Rev., 169: 1012-13(May 25, 1968).

The velocity dependence of the lifetime of the pion is investigated under the assumption that the Hamiltonian contains a spatial form factor which in the lab frame (the frame at rest with respect to the neighboring macroscopic bodies) vanishes for distances larger than some length α. In this model, there is a violation of the principles of special relativity at small distances. In particular, space-time is anisotropic at distances smaller than α. The lifetime of the pion is calculated to second order in α, and it is shown that there will be about 1% deviation from the usual formula $\tau(v) = (1 - v^2/c^2)^{-1/2}\tau(0)$, (which holds if special relativity is valid at arbitrarily small distances), if, e.g., the pion energy $E_\pi = 10^4$ MeV and $\alpha \sim 5 \times 10^{-16}$ cm. The measurement of the velocity dependence of the pion lifetime at high energies could thus serve as a possible check on the validity of special relativity at small distances. The deviation is of the same order of magnitude as that previously obtained for the muon decay. (auth)

35085 INFINITE VOLUME LIMIT OF A $\lambda\phi^4$ FIELD THEORY. Jaffe, Arthur M. (Harvard Univ., Cambridge, Mass.); Powers, Robert T. Commun. Math. Phys., 7: 218-21(1968).

A boson field with a $\lambda\phi^4$ self-interaction is studied. The vacuum-state functional in the theory with an ultraviolet cut-off, quantized in a box with periodic boundary conditions is studied in the limit of infinite volume keeping a fixed ultraviolet cut-off. It is shown that the vacuum functional converges to a regular state of the Weyl algebra of the canonical commutation relations. This state is translation invariant. It is believed that this infinite-volume state is not given by a density matrix in Fock space, although there is no proof. (J.F.P.)

35086 STATES ON CLIFFORD ALGEBRAS. Balslev, Erik; Verbeure, Andre (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 7: 55-76(1968).

States on Clifford algebras are studied from the point of view of C*-algebras. A criterion is given under which the odd-point functions vanish. A particular set of states, called quasi-free states is extensively studied and explicit representations are given: as an application an approximate calculation of the ground state of a fermion system is given.

35087 ON THE SIMPLICITY OF THE EVEN CAR ALGEBRA AND FREE FIELD MODELS. Doplicher, S.; Powers, R. T. (Princeton Univ., N. J.). Commun. Math. Phys., 7: 77-9(1968).

An example of a local rings system where the quasilocal algebra is a simple countably generated C*-algebra with unit is provided by the "local observables" for the free fermi field. (auth)

35088 APPARENT WEAKENING OF THE LOCALITY CONDITION. Pohlmeyer, K. (Univ., Hamburg). Commun. Math. Phys., 7: 80-92(1968). (In German).

For a hermitean, scalar, tempered field A(x) the locality axiom can be replaced by the following condition: For any two natural numbers n and j with $1 \leq j < n$ and for any configuration X(n,j): $X_1, \ldots, X_{j-1}, X_j, X_{j+1}, X_{j+2}, \ldots, X_n$ that is totally space-like in both orders: $1, \ldots, j-1, j, j+1, j+2, \ldots, n$ and $1, \ldots, j-1, j+1, j, j+2, \ldots, n$ there exist constants $\alpha(n,j) > 2$, $C(X(n,j)) > 0$, $h(X(n,j)) > 0$ such that with $x_k = X_k\sqrt{-x^2}$: $|\langle A(x_1) \ldots A(x_{j-1}) [A(x_j), A(x_{j+1})] A(x_{j+2}) \ldots A(x_n)\rangle| < C(X(n,j)) \exp\{-h(X(n,j))\sqrt{-x^2}^{\alpha(n,j)}\}$ for $-x^2 > 1$. (auth)

35089 NOTE ON THE DECREASE OF TRUNCATED WIGHTMAN FUNCTIONS FOR LARGE SPACE-LIKE SEPARATION OF THE ARGUMENTS. Pohlmeyer, K. (Univ., Hamburg). Commun. Math. Phys., 7: 271-3(1968).

The truncated Wightman functions cannot decrease arbitrarily fast for large space-like separation of the arguments. For certain configurations they can fall off at most exponentially. (auth)

35090 QUANTUM FIELD MODEL WITH UNRENORMALIZABLE INTERACTION. Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Commun. Math. Phys., 7: 289-304(1968).

The unitary relativistic model of quantum field theory with rapidly increasing spectral function (i.e., it grows faster than any finite power of momentum) is investigated. It is shown that there exist nontrivial Lagrangians, leading to this kind of spectral functions and allowing one to construct the local theory without the ultraviolet divergences on their basis. In this theory the S-matrix is unitary and not equal identically to unity. (auth)

35091 SOME REMARKS ON THE CHANGE OF STATE OF RELATIVISTIC QUANTUM MECHANICAL SYSTEMS BY MEASUREMENT AND ON THE LOCALITY REQUIREMENT. Schlieder, S. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Commun. Math. Phys., 7: 305-31(1968). (In German).

A description of relativistic quantum mechanical systems is introduced, in which the states depend on the possible information of the observer. The possibility of information is limited by Einstein-causality for classical systems ($\mathscr{C}_{kl}$). Observables belonging to measurements in finite regions of the Minkowsky space have a degenerate spectrum. The measurement of such an observable leads to a mixture; for the description of such a mixture a proposal first made by Lüders ($\mathscr{G}$) is used. The locality condition for the observables ($\mathscr{L}$) is assumed. This means the commutativity of two observables measured in two relatively space-like regions. The main result is the equivalence of ($\mathscr{L}$), ($\mathscr{G}$), ($\mathscr{C}_{kl}$) on the one side and ($\mathscr{M}$) and ($\mathscr{C}$) on the other side. ($\mathscr{C}$) is the Einstein-causality including quantum mechanical systems. The idealization of a measurement as a point event is used for the derivation of this result. (auth)

35092 CERTAIN NONRELATIVISTIC QUANTIZED FIELDS. Streater, R. F. (Univ. of Maryland, College Park). Commun. Math. Phys., 7: 93-8(1968).

Euclidean invariant interaction Hamiltonian which is a polynomial in smeared Fermion field operators (the smearing function providing an ultraviolet cut-off) is considered. By considering Guenin's perturbation series for the time-development of the theory, it is shown that time displacements define a one-parameter group of automorphisms of the field algebra at $t = 0$, which acts continuously in the time parameter. Results are obtained for any dimension of space and for both relativistic and nonrelativistic forms for the free Hamiltonian. In special cases the total Hamiltonian is a positive self-adjoint operator in Fock space, thus defining a concrete nonrelativistic quantized field with nontrivial particle production. (auth)

35093 ERGODIC STATES IN A NONCOMMUTATIVE ERGODIC THEORY. Doplicher, S.; Kastler, D. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 7: 1-20(1968).

Using the Godement mean $\mathcal{M}$ of positive-type functions over a group G, we study "$\mathcal{M}$-abelian systems" $\{\mathfrak{A},\alpha\}$ of a C*-algebra $\mathfrak{A}$ and a homomorphic mapping α of a group G into the homomorphism group of $\mathfrak{A}$. Consideration of the Godement mean of $f(g)\,U_g$ with f a positive-type function over G and U a unitary representation of G first yields a generalized mean-ergodic theorem. Then the Godement mean of $f(g)\pi(\alpha_g(A))$ with $A \in \mathfrak{A}$ and π a covariant representation of the system $\{\mathfrak{A},\alpha\}$ for which the G-invariant Hilbert space vectors are cyclic is defined, and its properties are studied notably in relation with ergodic and weakly mixing states over $\mathfrak{A}$. Finally the "discrete spectrum" of covariant representations of $\{\mathfrak{A},\alpha\}$ (i.e., the direct sum of the finite-dimensional subrepresentations of the associated representations of G). is investigated. (auth)

35094 EXTENSION OF INVARIANT PARTIAL STATES IN STATISTICAL MECHANICS. Emch, G. G.; Knops, H. J. F.; Verboven, E. J. (Univ., Nijmegen, Netherlands). Commun. Math. Phys., 7: 164-72(1968).

A class of physical systems often encountered in such theories as statistical mechanics, namely those which admit an amenable group as a group of symmetries is considered. First the existence of invariant state(s) is established with respect to the symmetry group considered. The notion of (extremal) potentially invariant states is introduced for a reduced description of the physical system considered; it is then shown that every such state can be extended to an (extremal) invariant state corresponding to a complete description. (auth)

35095 ALGEBRAS OF OBSERVABLES WITH CONTINUOUS REPRESENTATIONS OF SYMMETRY GROUPS. Kraus, Karl (Philipps Univ., Marburg, Ger.). Commun. Math. Phys., 7: 99-111(1968).

Concrete C*-algebras, interpreted physically as algebras of observables, are defined for quantum mechanics and local quantum field theory. A quantum mechanical system is characterized formally by a continuous unitary representation up to a factor U_g of a symmetry group $\mathfrak{G}$ in Hilbert space $\mathfrak{H}$ and a von Neumann algebra $\mathfrak{R}$ on $\mathfrak{H}$ invariant with respect to U_g. The set $\mathfrak{A}$ of all operators $X \in \mathfrak{R}$ such that $U_g X U_g^{-1}$, as a function of $g \in \mathscr{G}$, is continuous with respect to the uniform operator topology, is a C*-algebra called the algebra of observables. The algebra $\mathfrak{R}$ is shown to be the weak (or strong) closure of $\mathfrak{A}$. In field theory, a unitary representation up to a factor $U(a,\Lambda)$ of the proper inhomogeneous Lorentz group $\mathfrak{G}$ and local von Neumann algebras $\mathfrak{R}_c$ for infinite open space-time regions C are assumed, with the usual transformation properties of $\mathfrak{R}_c$ under $U(a,\Lambda)$. The collection of all $X \in \mathfrak{R}_c$ giving uniformly continuous functions $U(a,\Lambda)X\,U^{-1}(a,\Lambda)$ on $\mathfrak{G}$ is then a local C*-algebra $\mathfrak{A}_c$, called the algebra of local observables. The algebra $\mathfrak{A}_c$ is again weakly (or strongly) dense in $\mathfrak{R}_c$. The norm-closed union $\mathfrak{A}$ of the $\mathfrak{A}_c$ for all C is called algebra of quasilocal observables (or quasilocal algebra). In either case, the group $\mathfrak{G}$ is represented by automorphisms V_g resp. $V(a,\Lambda)$—with $V_g X = U_g X\,U_g^{-1}$—of the C*-algebra $\mathfrak{A}$, and this is a strongly continuous representation of $\mathfrak{G}$ on the Banach space $\mathfrak{A}$. Conditions for $V(a,\Lambda)$ can then be formulated which correspond to the usual spectrum condition for $U(a,\Lambda)$ in field theory. (auth)

35096 PARTICLE LOCALIZATION IN FIELD THEORY. Steinmann, O. (CERN, Geneva). Commun. Math. Phys., 7: 112-37(1968).

The localization properties of particles in field theory are studied with the help of a convenient mathematical description of counters. It is shown that field theory is capable of explaining the observed localization patterns. Apart from the usual axioms of field theory one has to assume some smoothness properties of the Green's functions in momentum space. (auth)

35097 CLASS OF RELATIVISTIC INVARIANT DISTRIBUTIONS. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Commun. Math. Phys., 7: 138-51(1968).

Space-time properties of a class of relativistic invariant distributions of the type $K(x - x') = \sum_{n=0}^{\infty} c_n/(2n)!\, \Box^n \delta^4 (x - x')$ were considered for different sequences of coefficients c_n. (auth)

35098 POSITIVE FUNCTIONALS ON ALGEBRAS OF TEST FUNCTIONS FOR QUANTUM FIELDS. Lassner, G.; Uhlmann, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Commun. Math. Phys., 7: 152-9(1968).

It is shown that the *-algebra R of test functions for a quantum field is reduced, i.e., for each $b \in R$, $b \neq 0$, there exists a positive continuous linear functional $W(a)$ on R with $W(b) \neq 0$. (auth)

35099 SPECTRAL REPRESENTATIONS OF LORENTZ INVARIANT DISTRIBUTIONS AND SCALE TRANFORMATION. Rieckers, A.; Guettinger, W. (Univ., Munich). Commun. Math. Phys., 7: 190-217(1968).

An approach to the theory of Lorentz invariant distributions is developed in terms of covariant spectral representations. The behavior of singular invariant distributions under a change of scale is analyzed. It is shown that the conventional extension of homogeneous singular functions into distributions in R^4, followed by a breakdown of homogeneity, is incomplete. Homogeneous extensions depending on an arbitrary scaling parameter are introduced, calculation techniques are developed and various formulas having applications in quantum field theory are derived. (auth)

35100 REMARKS ON THE QUANTUM FIELD THEORY IN LATTICE SPACE. I. Ezawa, Hiroshi (Univ., Hamburg). Commun. Math. Phys., 8: 261-8(1968).

The Gelfand functionals $E(f, g; a)$ for quantized fields ϕ in lattice space, a being the lattice constant, are calculated. In the limit $a \to 0$ the functionals take on two different forms depending upon the "potential" $F[\phi]$ of the lattice Hamiltonian (coupling between different lattice sites not included). If $F[\phi]$ is of a short-range type the limit functional is Gaussian. The corresponding representation of CCR is reducible and its realization apparently nonunique unless $F[\phi]$ is quadratic. The most natural realization is to represent the field as a linear combination of Fock fields whose masses are given by the excitation energies of the lattice Hamiltonian. If $F[\phi]$ is of a long-range type, the limit functional takes the more general form once studied by Araki. (auth)

35101 GENERALIZED EDGE OF THE WEDGE THEOREM. Kolm, A.; Nagel, B. (Royal Inst. of Tech., Stockholm). Commun. Math. Phys., 8: 185-203(1968).

The edge of the wedge theorem is generalized to the case where one only assumes the existence and equality of the distribution boundary values of $f_\pm(z)$ and all their derivatives on some analytic curve $\mathscr{C}$ in R^n. Here $f_\pm(z)$ are holomorphic in $R^n \pm iC$, respectively, where C is a convex cone, and $\mathscr{C}$ has its tangent vector in C at every point. Under these assumptions there exists an analytic continuation $f(z)$ holomorphic in some complex neighborhood of the double cone generated by $\mathscr{C}$. A proof is also given of the connection between the existence of a distribution boundary value and the growth of the holomorphic function near the boundary. (auth)

35102 RETARDATION EFFECTS AND GAUGE TRANSFORMATIONS IN THE BETHE–SALPETER EQUATIONS. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Ciafaloni, M.; Menotti, P. Nuovo Cim., 55A: 701-23(June 21, 1968).

The ladder Bethe–Salpeter equation with Feynman propagators gives rise to spurious corrections of order v/c to the nonrelativistic limit. The exact cancellation of these retardation effects by the introduction of the cross-graph interaction kernel is here rigorously proved for the case of scalar bosons. The electrodynamic case is then examined, and the appearance of these spurious terms is related to the lack of exact gauge invariance of the approximate Bethe–Salpeter equation. In particular, the gauge-transformation properties of the wave functions are established, and also the gauge invariance of the cross-graph equation is shown, up to order v/c. Finally, for the case of scalar bosons, a more general transformation is defined which leaves the S-matrix invariant, but gives rise to a purely instantaneous interaction in the ladder approximation. Transformations of this kind directly avoid the spurious retardation effects, even for theories which are not gauge invariant. (auth)

35103 FIELDS WITH NONLINEAR TRANSFORMATION LAWS UNDER CHIRAL $SU_3 \times SU_3$. Macfarlane, A. J.; Weisz, P. H. (Cambridge Univ., Eng.). Nuovo Cim., 55A: 853-8(June 21, 1968).

Some results needed for the construction of effective Lagrangians using fields with nonlinear transformation laws under chiral group

$K_3 = SU(3) \times SU(3)$ are presented. It is shown that a theory invariant under K_3, in which the only independent fields are a set of eight Hermitian pseudoscalar meson fields M_i ($i = 1,2,\ldots,8$) is unique to within canonical transformation of these fields, exhibits one possible form of such a theory. Further results are obtained for fields other than the fundamental fields M_i, and for covariant derivatives of fields. (L.B.S.)

35104 LADDER SERIES CONVERGENCE AND THE BETHE–SALPETER EQUATION. Mattioli, G. (Univ., Rome). Nuovo Cim., 56A: 144-72(July 1, 1968).

The convergence of the ladder-graph series is investigated in the case of the scattering of spinless particles in the direct channel. An appropriate Hilbert-space structure is introduced on the space of the off-shell wave functions, such that the B-S integral operator is bounded in this space and the convergence of the iterative off-shell series implies the convergence on shell. These results provide a more satisfactory justification for the use of the B-S integral equation and, furthermore, the introduced formalism enables the B-S equation to be written in the Hilbert space without any change of the symmetry properties. (auth)

35105 VARIATIONAL SOLUTIONS OF THE BETHE–SALPETER EQUATION. Ladanyi, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., 56A: 173-88 (July 1, 1968).

Variational procedures for obtaining approximate solutions of the Bethe–Salpeter equations are considered. Numerical calculations and illustrations were done in the bound-state region by solving the Bethe–Salpeter equation discussed by Schwartz. In the framework of the Rayleigh–Ritz method, rapid convergence is achieved by the variation of the nonlinear parameter. In order to present a starting point for solving more complicated problems, which are beyond the current scope of the Rayleigh–Ritz and Schwinger variational techniques, the least-squares method is discussed in detail. The numerical results indicate that the least-squares method can be accepted as a practical tool for the approximate solution of the Bethe–Salpeter equations. (auth)

35106 ONE-ELECTRON QUANTUM THEORY WITH DIRAC's $A^\mu A_\mu = m_0^2/\epsilon^2$ CONDITION. Rosen, G. (Drexel Inst. of Tech., Philadelphia). Nuovo Cim., 56A: 226-9(July 1, 1968).

It is shown that a suitable one-electron quantum theory may be obtainable from the Lagrangian density $L = -\frac{1}{4} F^{\mu\nu}F_{\mu\nu}$ and a spinor version of the condition $A^\mu A_\mu = m_0^2/\epsilon^2$. (L.B.S.)

35107 INTERPOLATING FIELDS FOR ELEMENTARY PARTICLES IN THE LEE MODEL. Zimmerman, R. L. (Univ. of Oregon, Eugene). Nuovo Cim., 56A: 15-28(July 1, 1968).

A general class of local interpolating fields consistent with the quantum numbers of the elementary V-particle in the Lee model is constructed. It is assumed that this class of interpolating fields converge weakly to the in and out fields associated with the V-particle. The matrix elements of the V-particle are then calculated. It is shown that the physical properties of the V-particle are independent of the form of the interpolating field. (auth)

Gravitation and General Relativity

Refer also to abstract 34185.

35108 (AD-666049) HARMONIC AND NULL DESCRIPTIONS OF GRAVITATIONAL RADIATION. Isaacson, Richard A.; Winicour, Jeffrey (Aerospace Research Labs., Wright-Patterson AFB, Ohio). 1968. 23p. CFSTI.

The problem of an axially symmetric space-time containing gravitational waves in the usual Bondi null coordinate system is considered. This Bondi frame is then related to asymptotically harmonic coordinates by means of a characteristic initial value problem. The resultant functional relation between the null and asymptotically harmonic frames is used to transform Bondi's radiative metric into its equivalent asymptotically harmonic form. This is then compared to the radiative solution which Fock has calculated directly using harmonic coordinates. In agreement with Fock, one finds that the harmonic form of the radiation metric contains logarithmic terms. The treatment clearly shows that these logarithmic metric components do not result from the well known logarithmic terms in the harmonic coordinate description of the light cones for Schwarzschild-like geometries. The principal result is that they arise from higher order radiative corrections. (USGRDR)

35109 GEOMETRIC AND PHYSICAL INTERPRETATION OF THE GUIDING FORMULA IN GENERAL RELATIVITY. Vigier, Jean-Pierre (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 598-600(Mar. 11, 1968). (In French).

The study of the solutions of the Laplace–Beltrami equation on the Riemann varieties (Σ) shows that the orthogonal trajectories to the equal phase surfaces are geodesics on the conform varieties (Σ') to the initial varieties (Σ). On (Σ') the quantum movement coincides with the movements predicted by Einstein. (tr-auth)

35110 INTRINSIC VECTOR AND TENSOR TECHNIQUES IN MINKOWSKI SPACE WITH APPLICATIONS TO SPECIAL RELATIVITY. Luehr, C. P.; Rosenbaum, M. (General Electric Co., Santa Barbara, Calif.). J. Math. Phys. (N. Y.), 9: 284-98(Feb. 1968).

An abstract formalism for tensor analysis in Minkowski space which entails notational simplicity and calculational advantages, as evidenced when compared with the usual component techniques, is described. The need to express tensor equations in component form is eliminated, and manipulations become formally the same as those in Euclidean space. The method is based on an extension to Minkowski space of the intrinsic concepts of vectors, differential operators, and polyadics in three-dimensional Euclidean space. Several examples from special relativity have been selected to illustrate the advantages of the formalism. In the first example, expressions in dyadic form for the Euler–Lagrange equations and canonical energy-momentum tensor are obtained and specialized to the electromagnetic field. From the electromagnetic-field dyadic, invariants and other useful relations are derived easily and economically. The dyadic form of the field equations is also shown to be particularly amenable for a derivation of the Dirac-like form of Maxwell's equations with the base elements of the Pauli algebra emerging in a most natural way. Further illustration of the practical utility of the method is given by considering several properties of the restricted homogeneous Lorentz transformations. Various dyadic expressions for these are obtained, and a detailed derivation of their eigenvalues and eigenvectors is given. By combining some of the results from the discussions of Lorentz transformations and the Dirac-like form of Maxwell's equations, it is shown how an isomorphism between the three-dimensional complex orthogonal group and the Lorentz group can be established in a simpler and different manner from other approaches appearing in the literature. (auth)

35111 EINSTEIN TENSOR AND SPHERICAL SYMMETRY. Plebanski, Jerzy (Centro de Investigacion y de Estudios, Mexico City); Stachel, John. J. Math. Phys. (N. Y.), 9: 269-83(Feb. 1968).

The classification of symmetric second-rank tensors in Minkowski space and its application to the Einstein tensor is reviewed. It is shown that, for spherically symmetric metrics, the Einstein tensor always has a spacelike double eigenvector; and the possible types of Einstein tensor that this degeneracy allows are discussed. A complete classification of all spherically symmetric metrics with two double eigenvalues is given. A study of the timelike eigencongruence, in the case when one timelike and two spacelike eigenvectors exist, is carried out. Canonical forms for the metric, the Einstein tensor, and the Weyl tensor (which is always of type D) are given for each of the various possible types. (auth)

35112 RADIATION DAMPING IN CONFORMALLY FLAT UNIVERSES. Hobbs, J. M. (Univ. of Newcastle upon Tyne, Eng.). Ann. Phys. (N. Y.), 47: 166-72(1968).

The equations of motion of a charged particle moving in a general Riemannian space, derived by Hobbs [Ann. Phys. (N. Y.) 47: 141 (1968)], are applied to conformally flat spaces. For these spaces the awkward integral term appearing in the equations is shown to vanish identically. In consequence the "tail" associated with an electromagnetic wave is constant and induced solely by the gauge corresponding to the vector potential. A subset of these spaces, which includes those with the de Sitter line element, is found in which the principle of equivalence is satisfied for a charged particle. (auth)

35113 EXPERIMENTAL MEASUREMENT OF THE EQUIVALENCE OF ACTIVE AND PASSIVE GRAVITATIONAL MASS. Kreuzer, L. B. (Princeton Univ., N. J.). Phys. Rev., 169: 1007-12(May 25, 1968).

A new type of gravitational experiment is reported, and a simple theoretical treatment in terms of Bondi's concepts of active, passive, and inertial mass is used to compare the results with other experiments. A homogeneous Teflon cylinder, which is completely immersed in a mixture of dibromomethane and trichloroethylene prepared to have about the same density as Teflon, was slowly moved back and forth in this liquid. The resultant time-varying gravitational field due to the density difference between the solid Teflon and the displaced liquid was detected by a Cavendish-type torsion balance placed outside of the liquid container. Buoyant forces on the Teflon were measured. The time-varying gravitational field detected by the balance was extrapolated to the condition of neutral buoyancy. The fractional density difference between the Teflon and the liquid required to produce this field was found to be $\Delta\rho/\rho = (1.2 \pm 4.4) \times 10^{-5}$. This upper bound of approximately 5×10^{-5} is compared to 10^{-3}, the best value that can be deduced from other experiments. (auth)

35114 EQUIVALENCE PRINCIPLE FOR MASSIVE BODIES. II. THEORY. Nordtvedt, Kenneth Jr. (Montana State Univ., Bozeman). Phys. Rev., 169: 1017-25(May 25, 1968).

The acceleration of a massive body in an external field for general space-time geometrical gravitational theories is obtained. The condition on the metric is such that $m_g/m_i = 1$ is obtained, and the result that $m_g/m_i = 1$ is obtained in Einstein's theory for massive objects with time-independent internal structure. But it is shown that a measurement of m_g/m_i for astronomical bodies would measure space-time metric components which have not been measured in other gravitational experiments. In the scalar-tensor gravitational theory due to Brans and Dicke, it is shown that m_g/m_i differs from 1 by a term of the order of the massive body's gravitational self-energy divided by its total energy. (auth)

35115 EQUIVALENCE PRINCIPLE FOR MASSIVE BODIES. I. PHENOMENOLOGY. Nordtvedt, Kenneth Jr. (Montana State Univ., Bozeman). Phys. Rev., 169: 1014-6(May 25, 1968).

The experimentally measured equality of inertial mass (m_i) and gravitational mass (m_g) of a body indicates nothing about the m_g/m_i ratio to the order of gravitational self-energy/total energy of the body. Experiments are discussed,using astronomical bodies, which measure m_g/m_i to the order of the gravitational self-energy of the bodies. The configuration of the stable three-body problem of Lagrange is shown to be particularly sensitive to the possible difference $\Delta \equiv m_g/m_i - 1$ of the Sun. (auth)

35116 INTERACTION BETWEEN ELECTROMAGNETIC AND GRAVITATIONAL WAVES. Cooperstock, Fred I. (Dublin Inst. for Advanced Studies). Ann. Phys. (N. Y.), 47: 173-81(1968).

A perturbation theory is developed for the interaction between free electromagnetic fields and weak gravitational fields. An effective four-current generator for the electromagnetic perturbation is explicitly derived. The theory is applied to calculate the change in the electromagnetic field and energy density of a high-frequency plane polarized monochromatic electromagnetic wave bounced between two perfectly conducting walls in the presence of a low-frequency gravitational wave. (auth)

35117 MODEL OF A SPINNING BODY WITHOUT GRAVITATIONAL RADIATION. Pechlaner, E.; Synge, J. L. (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., Sect. A, 66: 93-103(1968).

A massive body with three mutually perpendicular planes of symmetry spins with constant angular velocity about an axis lying in two of these planes. Outside the body, and concentric with it, there is a massive spherical shell. There is a vacuum between the body and the shell, and also outside the shell. The purpose of this paper is to construct a relativistic model to represent this situation. This is done by using a method of successive approximations to obtain a metric g_{ab} and an energy tensor T^{ab} in such a way that Einstein's field equations are satisfied to any desired degree of approximation, with $T^{ab} = 0$ in the vacuum domains and with positive density in the body and in the shell. There are two essential features of the method: (i) where d'Alembert's equation is to be solved, an equal mixture of retarded and advanced potentials is used, and (ii) where the metric outside the shell is made stationary at each step of the process by taking time-averages. The body is given the symmetry mentioned above, and is made to spin with constant angular velocity, in order to satisfy integrability conditions for certain partial differential equations. The same method can be used for a model in which the body does not rotate, but pulsates periodically, maintaining three mutually perpendicular planes of symmetry. In these models the field outside the shell is stationary and there is not gravitational radiation. On account of the assumed periodicity, there is no secular transfer of energy from the massive body to the spherical shell. (auth)

35118 VIERBEIN FORMALISM OF RADIATION DAMPING. Hobbs, J. M. (Univ. of Newcastle upon Tyne, Eng.). Ann. Phys. (N. Y.), 47: 141-65(1968).

The equations of motion of a charged particle moving in a general Riemannian space are derived. A vierbein treatment is adopted in contrast to the tensorial procedure of DeWitt and Brehme [see Ann. Phys. (N. Y.) 9, 220 (1960)] with a subsequent simplification of computations referring to the world tube. The resulting equations of motion differ from those of DeWitt and Brehme by the inclusion of terms involving the Ricci tensor. This discrepancy appears to be due to an error which is discussed. (auth)

35119 REGULAR NULL NETWORKS IN FLAT SPACE-TIME. Synge, J. L. (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., Sect. A, 66: 41-68(1968).

The edges of any one of the five Platonic solids may be regarded as a network in Euclidean 3-space constructed from a set of rods all of the same length. This idea is carried over into Minkowskian space-time, the common length being taken to be zero. In other words, networks of null segments are considered. On account of the indefiniteness of the metric, it is hopeless to seek such networks with the complete symmetry enjoyed by the Platonic solids. But a certain symmetry can be achieved by basing the construction on an initial pentad of events, four of them occurring simultaneously at the vertices of a regular tetrahedron in space and the fifth at the centroid. From this initial pentad, by use of null segments, a second pentad with tetrahedral symmetry is generated. From this second pentad a third is generated, and so on. It is found that each such step is controlled by one of four numerical 2 × 2 matrices. When a sequence of such matrix operations is applied, a null network is obtained, regular in the sense that it has at least the symmetry of the basic tetrahedron. Some of these networks are open and some are closed. Several of the more interesting sequences are investigated in detail, and the networks described not only formally but also by means of diagrams to scale, are projections from space-time on to the plane of the paper. No immediate physical consequences follow from these geometrical constructions, although the null segments admit interpretation in terms of the world lines or 4-momenta of photons or neutrinos. (auth)

35120 ALGEBRAIC SPECIAL EINSTEIN SPACES WITH ONE GROUP OF MOTION. Kramer, D.; Neugebauer, G. (Friedrich-Schiller Univ., Jena, Ger.). Commun. Math. Phys., 7: 173-80 (1968). (In German).

In algebraically special Einstein spaces ($R_{\mu\nu} = 0$) with a hypersurface-orthogonal spacelike Killing vector field ξ_ν, the trajectories of the multiple eigen null directions k_μ lie—except one case—in the subspaces V_3 orthogonal to ξ_ν ($k_\mu \xi^\mu = 0$) and are hypersurface-orthogonal. The solutions with vanishing expansion ($k_{,\mu;}{}^{\mu} = 0$, Kundt's class) can be determined explicitly. (auth)

35121 EMBEDDINGS OF THE PLANE-FRONTED WAVES AND OTHER SPACE-TIME. Collinson, C. D. (Univ. of Hull, Eng.). J. Math. Phys. (N. Y.), 9: 403-10(Mar. 1968).

The plane-fronted waves of general relativity are embedded in a six-dimensional pseudo-Euclidean space of signature −2. Two distinct families of embeddings are found. Embeddings of several well-known space-times are obtained. Certain results of J. Rosen are improved. (auth)

35122 LOCAL CHARACTERIZATION OF SINGULARITIES IN GENERAL RELATIVITY. Geroch, Robert (Palmer Physical Lab., Princeton, N. J.). J. Math. Phys. (N. Y.), 9: 450-83(Mar. 1968).

A new approach to singularities is formulated: their local description. Given any incomplete space-time M, a topological space, the "g boundary," is defined whose points consist of equivalence classes of incomplete geodesics of M. The points of the g boundary may be thought of as the "singular points" of M. Local properties of the singularity may now be described in a well-defined way in terms of local properties of the g boundary. For example, the notions: "dimensionality of a singularity," "past and future of a singular point," "neighborhood of a singular point," "spacelike or timelike character of a singularity," and "metric structure of a singularity" may all be expressed as properties of the g boundary. Two applications of the g boundary outside of the realm of singularities are discussed: In the case in which the space-time M is extendable (for example, Taub space), the g boundary is shown to be that regular 3-surface across which M may be extended [in this case, the Misner boundary between Taub and Newman-Unti-Tamburino (NUT) space]. With a slight modification of the definitions, the g boundary of an asymptotically simple space-time is shown to be Penrose's surface at "conformal infinity." The application of the g boundary technique to singularities is illustrated with a number of examples. The g-boundary structure of one particular example leads to consideration of non-Hausdorff space-times. (auth)

35123 TAIL OF A GRAVITATIONAL WAVE. Couch, W. E. (Syracuse Univ., N. Y); Torrence, R. J.; Janis, A. I.; Newman, E. T. J. Math. Phys. (N. Y.), 9: 484-96(Mar. 1968).

A first-order quadrupole sandwich wave of gravitational radiation exploding from a first-order Schwarzschild mass is examined to second order. If the second-order field preceding the sandwich wave vanishes, it is shown that the region of space-time following the sandwich wave contains a second-order, imploding quadrupole wave. The rest of the second-order field in the space-time region following the sandwich wave is also given, and it is seen to consist of monopole, quadrupole, and 16-pole nonradiative motions. (auth)

35124 FIRST-ORDER EQUATION FOR THE GRAVITATIONAL FIELD. Fedorov, F. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk SSSR, 179: 802-5(Apr. 1, 1968). (In Russian).

The general theory of relativistic wave equations of elementary particles is based on a standard equation $(\gamma^{\kappa}\partial_{\kappa} + \gamma^{0})\Psi = 0$; $\kappa = 1, 2, 3, 4$, which also applies to particles with zero rest mass. In this equation Ψ is a multicomponent function and γ^{κ}, γ^{0} are constant square matrices. It is of interest to examine the equations for which the above expression is universally valid. On the basis of the algebraic properties of the matrices γ^{κ}, γ^{0}, it is possible to obtain information concerning the properties of the solution of that equation, as applied widely in the theory of elementary particles. Einstein's gravitational field equation may also be expressed in a universal form. This problem was considered, deriving blocks of matrices, and presenting equations that may be used to study the gravitational field, specifically, to examine its exclusive nature in comparison with other fields. (TTT)

35125 MASS-ENERGY RELATION IN GRAVITATION. Carstoiu, John (International Consultant Scientists Corp., Brookline, Mass.). Compt. Rend., Ser. A and B, 266: 754-6(Apr. 1, 1968). (In French).

Brillouin and Lucas enlarged the framework of Newtonian gravitation by introducing the Einstein relation between mass and energy. A nonlinear equation was obtained that showed that gravitation is a nonlinear theory. The structure of this equation was examined, proceding by successive approximations. Magnetic charges are then introduced, and their introduction has the effect of doubling the mass distributed in the field. (tr-auth)

35126 ON THE SOLUTION OF THE EINSTEIN EQUATIONS IN THE GAUSSIAN COORDINATES. Korkina, M. P. (Dnepropetrovsk State Univ., USSR). Ukr. Fiz. Zh., 13: 647-50(Apr. 1968). (In Russian).

The solution of the free Einstein equations in the Gaussian coordinates for a spherically symmetrical gravitational field is obtained. This solution, unlike the Schwarzschild solution, has a singularity only at the beginning of the coordinates and may be used for the description of the gravitational field of an arbitrary small particle, point included. It is shown under which conditions the Schwarzschild solution and the one in the T-region can be obtained from the above solution. (auth)

35127 INVESTIGATION OF SOME PROPERTIES OF A GRAVITATIONAL FIELD WITH A METRIC FOR A PARTICULAR CASE OF ITS AXIAL SYMMETRY. Stepanyuk, N. M. (Ukrainian Agricultural Academy, Kiev). Ukr. Fiz. Zh., 13: 529-36(Apr. 1968). (In Russian).

A method is presented of obtaining an exact solution of gravitational equations for a certain particular case of statistical axial symmetry of a field. The expressions of density and pressure, components of curvature tensors and their invariants are found for the metric of the obtained solution, and a relation is shown between the presented solution and the known ones. The obtained solution is a generalization of the Schwarzschild intrinsic solution of a spherical symmetry for the case of a static axial symmetry of a gravitational field. (auth)

35128 INFLUENCE OF THE GRAVITATIONAL DEFLECTION OF LIGHT ON THE TIME OF OCCULTATION OF A STAR BY THE MOON. Rudkjoebing, M. (Univ. of Aarhus, Denmark). Nuovo Cim., 55B: 587-90(June 11, 1968).

The effect of the gravitational deflection of light on the times of occultation of a star by the moon is found to be large enough to be observed experimentally. The curvature of light rays in the static gravitational field of the sun is studied in order to extend the result for rays passing close to the sun to the general case of rays originating from stars observed in any direction. The magnitude of the effect is shown for distances between the sun and star that correspond to occultation taking place at about 2, 3, and 4 days after a new moon. (J.F.P.)

35129 METHOD FOR CONSTRUCTING CERTAIN AXIALLY-SYMMETRIC EINSTEIN-MAXWELL FIELDS. Perjes, Z. (Central Research Inst. for Physics, Budapest). Nuovo Cim., 55B: 600-3(June 11, 1968).

In order to find a method for constructing axially-symmetric Einstein–Maxwell fields two theorems are proven. The first is that there exists only a static cylindrical electromagnetic field for which $\Phi = A\phi + B$ holds, and the second is that a change in the sign of the gravitational constant causes the cylindrical static Einstein–Maxwell field problem to go over to a source-free cylindrical stationary gravitational field problem; the inverse statement holds too with a nonphysical sign of the gravitational constant. The results of these theorems are applied to the field equations. The results in the static electromagnetic aspect can be translated to the free stationary case and vice versa. The field which corresponds to the Kerr metric is constructed. (J.F.P.)

35130 TIMELIKE CHARACTER OF GRAVITATIONAL FIELD ENERGY–MOMENTUM. Deser, S. (Brandeis Univ., Waltham, Mass.). Nuovo Cim., 55B: 593-4(June 11, 1968).

It is shown that the classical gravitational field fulfils the basic physical criterion that any solution of finite energy content has forward timelike propagation character with $E > 0$, $-P_{\mu}P^{\mu} = M^{2} > 0$ Thus there are no gravitational systems with spacelike or even null four-momentum. The invariant mass M is the value of the energy in the rest frame. (J.F.P.)

Scattering Theory

Refer also to abstracts 34271, 34869, 34874, 34917, and 35409.

35131 (NP-17474) NARROW-RESONANCE SATURATION OF SUM-RULES: A NON-UNIQUENESS THEOREM. Note No. 149. Atkinson, D. (Rome Univ. (Italy). Istituto di Fisica). Jan. 15, 1968. 58p. Dep.

It is shown that, if the superconvergence relations pertaining to a two-particle scattering process are saturated by an infinite tower of resonances of mass m_J, where J is the spin, then m_J must increase less quickly than J in all cases. With this observation, it is shown that the complex of all the superconvergence relations for all the processes $a(J_1) + a(J_2) \rightarrow a(J_3) + a(J_4)$, where a(J) is the spin-J member of the same tower of particles, possesses an infinity of solutions for the coupling constants. It is concluded that the superconvergence relations are incomplete, and need to be supplemented by some new physical principle, if they are to be of any practical use. A possible exception to this rule is when all but a finite number of residues are constrained to be positive, with no negative coefficient from the isospin crossing matrices. In this case, a given solution may be unique if m_J increases not more quickly than $J^{1/2}$. (auth)

35132 ON THE ASYMPTOTICS OF INELASTIC PROCESSES WITH SMALL TRANSVERSE MOMENTUM. Kancheli, O. V. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 49: 551-6(Mar. 1968). (In Russian).

The Regge diagram method, suggested previously by V. N. Grebov (Regge Diagram Techniques, Preprint ITEF No 511, 1967), was expanded for inelastic processes with small transverse momenta and the asymptotics of corresponding amplitudes A(2 → n). (R.V.J.)

35133 GROUP FORMULATION OF POTENTIAL SCATTERING. Finkelstein, R.; Levy, D. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 8: 2147-53(Oct. 1967).

Potential scattering is formulated in terms of an integral equation on the group space of O_3. The potential need not be spherically symmetric except at large distances from the scattering center. (auth)

35134 INTERPOLATION FORMULAS IN THE ANGULAR MOMENTUM PLANE. Sabatier, Pierre C. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). J. Math. Phys. (N. Y.), 8: 1957-72(Oct. 1967).

When the potential is an analytic function of a rational power of r, analytical properties of the wave functions enable one to derive interpolation formulas in the angular-momentum plane. In these formulas, products of the wave functions which correspond to two different potentials are expanded in terms of their values at an infinite discrete set of points on the real axis. These expansions hold uniformly in z. Properties of the expansion coefficients are investigated. They allow one to construct generating functions, and to obtain several interpolation formulas for functions of mathematical physics. Results are applied to the inverse scattering problem at fixed energy. They provide further information on an "angular-momentum dispersion relation" obeyed by the Jost function. A semiclassical approximation is given for the interpolation coefficients, and its meaning is investigated. Finally, an elementary derivation of the interpolation formulas is sketched and suggests a curious symbolic writing of the wave functions. (auth)

35135 TIMELIKE CLUSTER PROPERTIES IN NONRELATIVISTIC SCATTERING. Taylor, John R. (Univ. of Colorado, Boulder). J. Math. Phys. (N. Y.), 8: 2131-7(Oct. 1967).

It is generally assumed that experiments which are sufficiently separated in space or time should be mutually independent. In scattering theory this independence is expressed by the cluster decomposition of the S matrix. It has been proved by Hunziker that for experiments which are separated in space the cluster property does hold in nonrelativistic scattering. The same result is proven for experiments which are separated in time. (auth)

35136 HIGH-ENERGY SCATTERING FOR YUKAWA POTENTIALS. Mueller, H. J. W.; Schilcher, K. (American Univ. of Beirut). J. Math. Phys. (N. Y.), 9: 255-9(Feb. 1968).

A re-examination is made of nonrelativistic scattering by a superposition of Yukawa potentials in the frame of a high-energy perturbation method developed previously. It is found that for Yukawa potentials expandable in ascending powers of r, the S matrix may be written in a remarkably simple form. A high-energy asymptotic expansion is obtained for the phase shift. The residue function at the Regge poles is found to have the same general form as for a Coulomb potential and is formally independent of any high-energy approximation. (auth)

35137 ON THE POSSIBILITY FOR A SUPERCONVERGENT AMPLITUDE TO DISPLAY A DIFFRACTIONLIKE BEHAVIOR. Caprasse, H. (Service de Physique Mathematique, Liege). Nuovo Cim., 55A: 472-81(June 1, 1968).

A strong difference between the superconvergence condition $\lim_{s \to \infty} s|T| = 0$ (where T is some invariant amplitude) and the diffraction requirement $\lim_{s \to \infty} (\mathrm{Re}T)/(\mathrm{Im}T) = 0$ is pointed out. Though the latter condition allows us to deduce the former one, the asymptotic behavior of T is further restricted in such a way that only invariant amplitudes dominated by the Pomeranchuk trajectory and its daughters may still be considered. This result is obtained without any use of the analytic properties of T in the angular-momentum plane. (auth)

35138 DOUBLE REGGE MODEL AND DENSITY-MATRIX ELEMENTS IN SINGLE-PARTICLE PRODUCTION. Capella, A.; Ranft, G. (CERN, Geneva). Nuovo Cim., 55A: 507-21(June 1, 1968).

A formalism is developed which allows one to take spin fully into account in three-body production. Expressions for the density-matrix elements are given. The double Regge model is used to compare the density matrix of a resonance produced in a three-body production process with the corresponding density matrix in a two-body reaction having in common the vertex at which the resonance is produced. (auth)

35139 SIMPLE MODEL CONTAINING DAUGHTERS. Landshoff, P. V. (Univ. of Cambridge, Eng.). Nuovo Cim., 55A: 572-6(June 1, 1968).

A simple model, related to the sum of ladder diagrams, is shown to contain a parent Regge trajectory with its daughter, granddaughter etc., and no others. Other trajectories can be introduced by making modifications to the model. (auth)

35140 LOW-ENERGY SCATTERING BY LONG-RANGE SINGULAR POTENTIALS. Handelsman, R. A.; Pao, Young-ping; Lew, J. S. (Brown Univ., Providence). Nuovo Cim., 55A: 453-71(June 1, 1968).

The quantum-mechanical problem of low-energy scattering by inverse-power repulsive potentials is considered. A method capable of generating all the terms in the low-energy asymptotic expansions of the phase shifts is presented. This method is based on the approach of inner-outer expansions and may be extended to more general singular long-range potentials. The computational procedure demonstrates clearly the mathematical origin of all the terms in the asymptotic expansions of the phase shifts. (auth)

35141 SIMPLE FORMULATION OF HIGH-ENERGY EXCHANGE MODELS IN TERMS OF DIRECT-CHANNEL AMPLITUDES. Cohen-Tannoudji, G. (CERN, Geneva); Salin, Ph.; Morel, A. Nuovo Cim., 55A: 412-22(June 1, 1968).

Relations between s-channel helicity amplitudes implied, in an exchange model, by parity and G-parity conservation at each vertex, are derived. This allows high-energy exchange models to be formulated in terms of direct-channel amplitudes. In the framework of the Regge-pole model the effects of "evasive" and "conspiratorial" solutions are examined and visualized on experimentally accessible quantities. It is shown that a solution which would be "conspiratorial" in all processes involving particles with arbitrarily large spins is very unlikely since it would imply that particles have no definite parity. (auth)

35142 CORRESPONDENCE BETWEEN UNSTABLE PARTICLES AND POLES IN S-MATRIX THEORY: THE EXPONENTIAL DECAY LAW. Calucci, G.; Ghirardi, G. C. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Phys. Rev., 169: 1339-42(May 25, 1968).

The discussion on the correspondence between unstable particles and poles of the S matrix, started in a previous paper, is continued with particular attention to the decay law. It is shown that the previous formalism can be modified to obtain an S matrix, satisfying all the usual requirements of analyticity, unitarity, and asymptotic behavior, which exhibits an isolated resonance with exponential decay without an accompanying pole in the unphysical sheet. The existence of a local potential which yields the S matrix considered is also proved. (auth)

35143 SOLUTIONS OF THE FADDEEV EQUATION FOR SHORT-RANGE LOCAL POTENTIALS. Ball, James S. (Univ. of California, Los Angeles); Wong, David Y. Phys. Rev., 169: 1362-5(May 25, 1968).

A systematic method for solving the Faddeev equation for three bodies interacting through two-body local potentials is presented. This method is then applied to the problem of three identical particles interacting through a Yukawa potential, and the convergence of the method is studied numerically. Solutions are obtained for one particle scattering off a bound state of the other two, as well as for the three-particle bound-state case. (auth)

35144 ANALYTICITY REQUIREMENT FOR REGGE POLES AND BACKWARD UNEQUAL-MASS SCATTERING. Kim, Y. S. (Univ. of Maryland, College Park); Resnikoff, M. Phys. Rev., 169: 1288-93(May 25, 1968).

A Regge amplitude is constructed for the backward unequal-mass scattering which satisfies the Mandelstam representation. This amplitude is analytic at s = 0 for large u. It is shown that the leading term gives the Regge behavior $u^{\alpha(s)}$ at s = 0 and in its neighborhood, including the region in which the cosine of the backward scattering angle is bounded. Nonleading terms such as $u^{\alpha(0)-1}$ and $u^{\alpha(0)-1} \ln u$ are also obtained. The possibility of writing these nonleading terms as a sum of fixed and moving poles with a singular coefficient is considered. A comparison with experiment is made. (auth)

35145 KINEMATIC SINGULARITIES AND THRESHOLD RELATIONS FOR HELICITY AMPLITUDES. Jackson, J. D. (Univ. of California, Berkeley); Hite, G. E. Contract W-7405-eng-48. Phys. Rev., 169: 1248-74(May 25, 1968). (UCRL-17959).

The kinematic singularities of two-body helicity amplitudes at thresholds and the concomitant relations among these amplitudes are discussed in a direct and elementary way, without recourse to the singularity structure of the crossing matrix. The tools are those of nonrelativistic quantum mechanics, as befits a situation where p → 0, with spins combined into channel spins S and Russell-Saunders coupling of L + S = J. The kinematic singularities are shown to follow from a mismatch between J and L for each term in the partial-wave series. The method is applicable at pseudothresholds $(m_1 - m_2)^2$ as well as normal thresholds $(m_1 + m_2)^2$ with two formal changes involving an intrinsic parity and a helicity-dependent phase. The relations among the different helicity amplitudes at the thresholds are shown to result from the presence at threshold of fewer Russell-Saunders amplitudes than there are independent helicity amplitudes. The use of invariant amplitudes is shown to be an alternative which automatically yields the kinematic singularities and also the threshold relations among the helicity amplitudes. A discussion is given of dynamical exceptions to the threshold constraints, resulting from less singular than standard behavior at a threshold. The threshold relations are important constraints on the amplitudes, and must be satisfied by any realistic model. In the use of t-channel amplitudes for peripheral processes in the s channel, the explicit imposition of all the relations at the t-channel thresholds is necessary in order to assure a differential cross section without spurious, polelike singularities in t whose variation could in some circumstances completely control the t dependence. The reactions $\pi N \to KY$ and $\pi N \to \pi' \Delta$ are used as illustrations. The latter process is especially illuminating because its t-channel amplitudes have a pole (rather than a simple inverse-square-root singularity) at the $\bar{N}\Delta$ pseudothreshold, $t = 0.09\ (\mathrm{GeV}/c)^2$. The proximity of this point to the physical region of the s channel means that the threshold relations there are of crucial importance. The consequences of these constraints on the cross section and decay density matrix of the Δ are discussed within the framework of the Regge-pole model. Comparison with experiment implies that the dynamics make the amplitudes for $\pi\pi' \to \bar{N}\Delta$ have less than the standard kinematic singularity at $\bar{N}\Delta$ pseudothreshold and so avoid almost all the threshold constraints. Examples are cited from the literature where use of Regge-pole formulas possessing the spurious kinematic factors has led to incorrect inferences concerning the dynamic behavior of Regge residues. (auth)

35146 SCATTERING AMPLITUDES GENERATED BY POLE TERMS OF REGGE-TYPE REPRESENTATIONS. Mukherjee, Suprokash; Shastry, C. S. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., 169: 1234-40(May 25, 1968).

Calculations of partial-wave amplitudes are performed for various Regge-type representations for attractive Yukawa potentials, and the results are compared with those obtained from exact calculations. (auth)

35147 USE OF BORN APPROXIMATIONS IN N/D CALCULATIONS. Collins, P. D. B.; Johnson, R. C. (Univ. of Durham, Eng.). Phys. Rev., 169: 1222-31(May 25, 1968).

The N/D equations were solved with the first, second, and third Born approximations to the left-hand cut, for nonrelativistic, single-channel potential scattering, with potentials involving combinations of attraction and repulsion of different ranges, and the results are compared with the exact solution of the Schrödinger equation. It is found that for the sort of potential strengths which occur in strong-interaction dynamics, the third Born approximation is satisfactory. It is known that the first Born approximation, which is commonly used, suffers from several defects in that long-range repulsions can produce attractive effects, and "ghosts" appear on the physical sheet, and we explore the way in which the approximation breaks down. It is concluded that in dynamical calculations, such as those involving the strip approximation, much more satisfactory results are likely to be obtained if the left-hand cut is calculated from a few iterations of the potential. (auth)

35148 RELATIONS AMONG THE SUPERCONVERGENCE CONDITIONS FOR FORWARD ELASTIC SCATTERING. III. GENERAL METHOD TO OBTAIN ALL INDEPENDENT SUPERCONVERGENCE CONDITIONS FOR FORWARD AMPLITUDES. Lin, Keh Ying (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 169: 1203-17(May 25, 1968).

The superconvergence conditions for forward elastic scattering of two spinning particles are discussed. The crossing relation implies that the t-channel forward amplitude is related to those s-channel forward amplitudes which do not flip helicities by more than 1. Therefore, in general, the superconvergence conditions for the t-channel forward amplitudes do not exhaust all possible superconvergence conditions for forward amplitudes. A general method to obtain all independent superconvergence conditions for the s-channel forward amplitudes is described. The linear relations among the derivatives (with respect to t) of the t-channel helicity amplitudes at t = 0 are derived and discussed. (auth)

35149 MISUSES OF THE FINITE-ENERGY SUM RULES. Mandula, Jeffrey E.; Slansky, Richard C. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev. Lett., 20: 1402-5(June 10, 1968).

It is shown that any model in which the scattering amplitude is given by finitely spaced trajectories of direct-channel resonances does not yield Regge asymptotic behavior in the direct channel. Several difficulties associated with the use of Regge asymptotic behavior at low values of the energy through the finite-energy sum rules are noted. (auth)

35150 PHYSICAL REGION FOR SCATTERING AND DECAY PROCESSES INVOLVING FIVE PARTICLES. Nyborg, Per (Agricultural Coll. of Norway, Vollebekk). Phys. Norv., 2: 243-8(1967).

The kinematics of processes involving five different particles is discussed. Five variables are involved. For convenience, one is kept as an angular variable which can be integrated away when no spins are involved, the other four are transformed into covariant scalars. The geometry (in the space of the four covariant variables) of the physical regions for the various processes is a generalization of the two-dimensional geometry for four-particle processes. (auth) (Norway)

35151 POMERANCHUK TRAJECTORY AND ITS RELATION TO LOW-ENERGY SCATTERING AMPLITUDES. Harari, Haim (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Lett., 20: 1395-8(June 10, 1968).

While "ordinary" Regge trajectories can be bootstrapped using the resonance approximation to finite-energy sum rules, it is suggested that the Pomeranchuk trajectory is mostly built from the nonresonating background at low energies. This hypothesis (a) explains the constancy of KN and NN total cross sections (in contrast to $\bar{K}N$ and $\bar{N}N$) over a wide energy range; (b) predicts many other interesting relations which are experimentally satisfied; and (c) leads to no obvious inconsistencies. (auth)

35152 MOMENTUM TRANSFER DISPERSION RELATIONS FOR THREE-PARTICLE POTENTIAL SCATTERING AMPLITUDES. Hartle, J. B.; Sugar, R. L. (Univ. of California, Santa Barbara). Phys. Rev., 169: 1104-14(May 25, 1968).

The analytic properties in momentum transfer of a class of three-particle scattering amplitudes are investigated in this paper. The amplitudes considered are those in which there is a two-particle bound state in both the initial and final state. The following results are obtained: (1) The amplitudes are analytic inside a Lehmann ellipse in the scattering angle for all real energies. (2) For real energies below the three-free-particle threshold, the amplitudes are analytic in the momentum transfer plane except for real left- and right-hand cuts. (auth)

35153 NEW CRITERION FOR NONOSCILLATING HIGH-ENERGY BEHAVIOR OF SCATTERING AMPLITUDES. II. APPLICATIONS. Gervais, J.-L.; Yndurain, F. J. (New York Univ., N. Y.). Phys. Rev., 169: 1187-91(May 25, 1968).

The condition for nonoscillation of scattering amplitudes at high energy, proposed in a previous paper by the authors, is applied to show that (i) fast oscillations can be incorporated into the picture by taking into account the finite resolution of physical apparatus, (ii) finite-energy sum rules are equivalent to the fulfillment of the criterion, (iii) Regge cuts lead to nonoscillating behavior in our sense, (iv) the criterion may still be satisfied when the leading singularities in the complex l plane are more general than the usual cuts and poles. (auth)

35154 UNITARITY AND INELASTIC PROCESSES. Selleri, F. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cim., 55A: 522-6(June 1, 1968).

The transitions between two states |1> and |2> describing two different sets of particles are considered. It is shown that unitarity alone specifies completely the matrix element for the considered process, once other matrix elements at the same energy are given, if there is at least one further state |3> to which the states |1> and |2> can make a transition. Possible applications are discussed. (auth)

35155 BOUNDARY VALUES OF ANALYTIC FUNCTIONS. Constantinescu, Florin (Univ. of Cluj). Commun. Math. Phys., 7: 225-33(1968).

It is known that a complex-valued continuous function S(x) as well as a Schwartz distribution on the real axis can be extended in the complex plane minus the support of S to an analytic function $\hat{S}(z)$. In the case of a continuous function the jump of $\hat{S}(z)$ on the real axis represents exactly S(x): $\lim_{\epsilon\to 0+} [\hat{S}(x + i\epsilon) - \hat{S}(x - i\epsilon)] = S(x)$. A point x on the support of S such that $\lim_{\epsilon\to 0+} [\hat{S}(x + i\epsilon) - \hat{S}(x - i\epsilon)]$ exists is called regular. Conditions are found for the existence of regular points on the support of a distribution. It is possible to call this limit (if this exists) the value S(x) of the distribution S in the point x. Properties of this type occur in the theory of dispersion relations. (auth)

35156 SUBALGEBRAS WHICH SURVIVE CONTRACTION. Domokos, Gabor; Tindle, Graham L. (Univ. of California, Berkeley). Commun. Math. Phys., 7: 160-3(1968).

The following theorem is proven: if a subalgebra B of an algebra G is spanned by root vectors, then if X is a regular element of G, the limit $\lim_{t\to\infty}$ Ad expt X(B) exists and is isomorphic to B, i.e., B "survives" contraction with X. The algebra SL(2C) is considered as an example. In particular it is shown that SL(2C) itself survives and applications to relativistic scattering theory are indicated. (auth)

35157 ASYMPTOTIC CONDITION OF SCATTERING THEORY. Jauch, J. M. (Univ., Geneva); Misra, B.; Gibson, A. G. Helv. Phys. Acta, 41: 513-27(July 1, 1968).

A new and more general asymptotic condition for scattering systems is formulated. It is based on a physically motivated topology in the set of all states. This topology turns out to be the same as that induced by the trace norm. The existence of wave operators is demonstrated in this more general setting and the relation of these generalized wave operators to the conventional ones is clarified. A simple example is mentioned of a system which satisfies the new but not the old asymptotic condition. (auth)

35158 SOME REMARKS ON SINGULAR ATTRACTIVE POTENTIALS. Behncke, H. (Indiana Univ., Bloomington. Univ. of California, Irvine). Nuovo Cim., 55A: 780-5(June 21, 1968).

The difficulties with singular attractive potentials are traced to the fact that they lead to nonself-adjoint Hamiltonians. These are not acceptable in the framework of quantum mechanics. (auth)

35159 FINITENESS OF WAVE FUNCTIONS. Morrow, R. A. (Dartmouth Coll., Hanover, N. H.). Nuovo Cim., 55A: 827-8 (June 21, 1968).

A finiteness principle for wave functions is studied and found to have support in the context of collision theory. The principle requires that a wave function of interacting particles which is normalizable a long time before the interaction has occurred be finite a long time after the interaction has occurred. (L.B.S.)

35160 EVALUATION OF THE POTENTIAL AND THE S-WAVE SCATTERING AMPLITUDE FROM THE DISCONTINUITY

OF THE LATTER ACROSS ITS LEFT-HAND CUT. Calogero, F. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Cox, J. R. Nuovo Cim., 55A: 786-808(June 21, 1968).

A procedure, based on the Marchenko solution of the inverse scattering problem, is described, whereby the spectral function (inverse Laplace transform) of the potential is obtained by means of step-by-step sequential integration from the discontinuity of the S-wave scattering amplitude across its dynamical cut; it is complementary to that introduced by Martin to compute the S-wave scattering amplitude from the spectral function of the potential. This same procedure also yields the S-wave scattering amplitude itself; its connection with the N/D approach is elucidated. The consideration is restricted to short-range potentials representable as Laplace transforms; the case with bound states is analyzed in detail. The connection with earlier related work of Martin and others is discussed. (auth)

35161 CAUSALITY GROUPS OF S-MATRIX. Santilli, R. M. (Univ. of Miami, Coral Gables, Fla.). Nuovo Cim., 55B: 578-86(June 11, 1968).

The discussion of causality groups of the S-matrix covers a real and a complex Minkowski space, the connection between Zeeman causality and microcausality, and the causality groups of LSZ and Wightman formulations. The agreement which exists between the causality group and microcausality allows one to conclude that causality conditions are well defined for free asymptotic states, but for interpolating states this is not the case. (J.F.P.)

35162 MODEL FOR INELASTIC SCATTERING AT HIGH ENERGIES. Andreev, I. V.; Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 890-4(Apr. 1968). (In Russian).

A simple model for inelastic interactions with great number of secondary particles is presented. The elastic scattering due to the considered inelastic interaction has a diffraction peak decreasing exponentially with $|t|$. The model makes it possible to obtain analytical expressions for various characteristics of inelastic processes (differential cross sections, multiplicity distributions, total cross sections, and so on). Possible modifications of the model are discussed. (auth)

35163 ON THE ELIMINATION OF t CHANNEL THRESHOLD SINGULARITIES FROM THE DIFFERENTIAL CROSS SECTION. McKerrell, A. (Cambridge Univ., Eng.). Nuovo Cim., 56A: 349-52(July 1, 1968).

The relation between helicity and transversity amplitudes is used to prove, in the case of general mass and arbitrary spin, that the square of the modulus of a transversity amplitude, with the correct interpretation of its continuation to the neighborhood of thresholds and pseudo-thresholds in t, has no singularity there. Explicit formulas are given which allow a parametrization independent of the kinematics. (L.B.S.)

35164 RELATIVISTIC RELATED OPERATORS AND RETARDED MULTIPOLE ENERGIES AT RESONANCE. Gomberoff, L. (University Coll., London). Nuovo Cim., 56A: 97-106(July 1, 1968).

A fully retarded Hamiltonian is derived for exchange interactions between two neutral atoms with no permanent moments. This is done by using S-matrix theory to second order in the coupling constant between the charges and the electromagnetic field. The use of the S-matrix formalism enables one to introduce not only the Coulomb interaction between the two systems but also the full Maxwell field. For small R this Hamiltonian yields the nonretarded energies obtained from the Coulomb field alone. Departures from this limit begin to be important at separations of the order of the reduced wavelength ƛ of the transition. Using the formalism derived in a previous paper (and used here for exchange interactions only), a general expression for elastic-multipole interactions is given, together with the potential for magnetic-dipole interactions. (auth)

Particle Accelerators

Refer also to abstract 35217.

35165 (AD-661794) THE NOL VAN DE GRAAFF FACILITY. Evans, Albert E.; Simons, Donald G. (Naval Ordnance Lab., White Oak, Md.). June 28, 1967. 143p. (NOLTR-67-102). CFSTI.

The Naval Ordnance Laboratory's 2.5 MeV Van de Graaff positive-ion accelerator is described. This machine was originally a 2 MeV x-ray generator built for the Navy in 1943 by MIT Laboratories. The design of the present facility and technical problems connected with conversion and updating of the machine are discussed. Instructions are given for its operation and maintenance. (auth) (USGRDR)

35166 (AD-663169) DESIGN, CONSTRUCTION, TESTING, AND USE OF A CRYOGENIC ALIGNED NUCLEAR TARGET ASSEMBLY. Final Report, March 15-October 14, 1965. (Stanford Univ., Calif. Dept. of Physics). 1967. Contract Nonr-225(86). 2p. CFSTI.

A brief summary is given of work involving the Stanford Cryogenic Oriented Nuclear Target (SCONT), especially its use in studies of Ho165 electron scattering and neutron transmission. A list of publications resulting from the work is included. (USGRDR)

35167 (AD-665866) ON A NEW SOURCE OF HIGHLY STRIPPED HEAVY IONS. Daugherty, J. D.; Grodzins, L.; Jones, G. S.; Levy, R. H. (Avco-Everett Research Lab., Everett, Mass.). Jan. 1968. Contracts AF49(638)-1553; AT(30-1)-3863. 13p. (AERL-RR-288; AFOSR-68-0348; NYO-3863-3). CFSTI.

A new source of highly stripped heavy ions is suggested based on the principles of the HIPAC (Heavy Ion Plasma Accelerator). The mode of operation and estimated performance of the ion source are discussed and a brief description of relevant experiments is given. Based on an electron density of 2×10^{10}/cc and a containment time of 10 seconds, it should be possible to produce, for example, U + 60 (60 times ionized uranium) at a rate of 10^{11} ions per second. (auth) (USGRDR)

35168 (BNL-12494) RECENT PROGRESS IN LINAC PRE-ACCELERATORS. Sluyters, Th. J. M. (Brookhaven National Lab., Upton, N. Y.). [1968]. 12p. (CONF-680515-1). Dep. CFSTI.

From Conference on Proton Linear Accelerators, Upton, N. Y.

Developments in preinjectors, concentrated on beam currents below 200 mA, with the object to pre-accelerate, transport, and bunch beams without dilution and to match them to the longitudinal and transverse phase spaces of the linear accelerator, are discussed. Ion source developments, results obtained with low and high gradient acceleration without significant apparent dilution up to 750 keV with and without prefocusing, and the low energy beam transport system between the accelerator and the linac are examined. (W.H.K.)

35169 (BNL-12537) MESH-ITERATION PROGRAM FOR FIELD CALCULATIONS IN LINAC CAVITIES. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). [1968]. 7p. (CONF-680515-2). Dep. CFSTI.

From Conference on Proton Linear Accelerators, Upton, N. Y.

The application of the JESSY mesh-iteration computer program to the calculation of the fields and resonant frequency of cells in a 200-MeV proton linac is discussed. The iteration procedure, convergence acceleration technique, and the accuracy of the JESSY program are reported. (W.H.K.)

35170 (CEAL-1040) CALIBRATION AND PERFORMANCE OF CEA QUANTAMETERS. Dell, George F.; Fotino, Mircea (Cambridge Electron Accelerator, Mass.). May 1, 1968. Contract AT(30-1)-2076. 28p. (CONF-680430-1). Dep. CFSTI.

From Symposium on Beam Intensity Measurement, Daresbury, England.

Five gas-filled quantameters and two evacuated units for use as nonsaturable secondary emission quantameters were tested. Saturation curves, ion collection curves, stability, and dependence of monitor response on absorber in the beam are presented. (W.H.K.)

35171 (CERN-68-18) OPTIMISATION DES PARAMETRES DES SYSTEMES ACCELERATEURS HF A LARGE BANDE. (Optimization of the Parameters of the HF Accelerator Systems Over a Wide Band). Giannini, R.; Susini, A. (European Organization for Nuclear Research, Geneva (Switzerland)). May 15, 1968. 63p. (In French). Dep.

A systematic search is undertaken to find suitable coupling networks between the generator and the resonator when the latter is fixed-tuned and has to be operated over a moderately wide band of frequencies. The most important parameters, and the damping coefficient, which minimize the tube rating, are calculated. It is shown that the optimum conditions differ according to whether operation is continuous or pulsed. (auth)

35172 (LA-3948) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Status Report for the Period Ending April 30, 1968. (Los Alamos Scientific Lab., N. Mex.). May 1968. Contract W-7405-eng-36. 42p. Dep. CFSTI.

The medium-energy physics program developments at LASL which deals with the Los Alamos Meson Physics Facility is discussed. Topics discussed include accelerator structures, rf power supplies, accelerator control and instrumentation, experimental area, and scheduling and facility construction. (W.H.K.)

35173 (NP-tr-1663) SCATTERED RADIATION IN ACCELERATOR HALLS. Kimel, L. R.; Komochkov, M. M.; (and others)

(Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by E. W. Kendall (Atomic Energy Research Establishment, Harwell, Eng.), from report JINR-P9-3402. 32p. Dep. CFSTI. UK.

The problems of stray radiation in accelerator halls have been considered. Approximate formula for calculation of stray radiation fluxes of different energy groups are obtained. The method suggested is applied for calculations of stray radiation fields at the JINR synchrocyclotron hall. (auth)

35174 (ORNL-4217, pp 96-118) OAK RIDGE ISOCHRONOUS CYCLOTRON. (Oak Ridge National Lab., Tenn.).

The development of the Oak Ridge Isochronous Cyclotron during 1967 is discussed. Topics include magnetic field calculations, rf regulation, beam improvement and development, and polarized ion source and its components. An operations summary is also presented. (B.G.D.)

35175 (ORNL-4217, pp 119-39) ADVANCED ACCELERATOR DEVELOPMENT. Howell, L. N.; Hudson, E. D.; Livingston, R. S.; Mann, J. E.; Martin, J. A.; Mosko, S. W.; Richardson, E. G. Jr.; Worsham, R. E.; Ziegler, N. F. (Oak Ridge National Lab., Tenn.).

The developments which occurred during 1967 on the Separated Orbit Cyclotron Experiment and the Separated Orbit Cyclotron are discussed. Topics relative to the SOCE include rf components, vacuum system, beam control system, magnet design and construction. Topics associated with the SOC include a prototype magnet and rf systems. A brief abstract of a paper on the Separated-Turn Isochronous Cyclotron is also presented. (B.G.D.)

35176 IMPROVEMENTS IN OR RELATING TO PARTICLE ACCELERATING TUBES. Howe, Frederick Albert; Bell, Ronald Inch (to United Kingdom Atomic Energy Authority). British Patent 1,116,442. June 6, 1968. Filed Nov. 19, 1964.

A design for a linear particle accelerating tube suitable for use with electrostatic generators, for example, of the Van de Graaff type is presented. The accelerating tube is comprised of a plurality of spaced apertured electrodes which includes at least two pairs for providing axially localized transverse magnetic fields separated from one another by substantially magnetic field-free regions, each successive pair of localized fields being oriented to deflect the accelerated particle beam from one selected path substantially parallel to the tube axis in such a manner as to minimize the net displacement from the tube axis of the beam emerging from the tube while deflecting unwanted electrons into the electron beam. (B.G.D.)

35177 IMPROVEMENTS IN OR RELATING TO PARTICLE ACCELERATOR TUBES. Allen, William Douglas; Dawton, Ralph Herbert Vernon Mordaunt; Broad, Donald Anthony Gifford (to Science Research Council). British Patent 1,116,441. June 6, 1968. Filed Aug. 28, 1964.

A design is presented for a linear particle accelerator tube for use with electrostatic generators, for example of the Van de Graaff accelerator type. The accelerator tube is comprised of a plurality of electrodes in which the region adjacent to the beam has its general plane normal to the tube axis but has its inner edge circumferentially corrugated each electrode being rotated about the tube axis by the same angle relative to the previous electrode so that the net tangential deflection of the beam is substantially zero. (B.G.D.)

35178 ANOTHER INTERPRETATION OF THE OPTICAL SCALARS. Kantowski, R. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.), 9: 336-8(Feb. 1968).

An interpretation of the optical scalars θ and σ (the expansion and shear of an irrotational null congruence) is given in terms of the principal curvatures of a two-dimensional subspace of the instantaneous rest frame of an arbitrary observer. The two space is defined as the intersection of the observer's rest frame and the particular null hypersurface the observer is intersecting. (auth)

35179 MEASUREMENT OF RADIATION DOSE OUTSIDE THE NEUTRON GENERATOR ROOM. Takeshita, Kenji (Hiroshima Univ.); Antoku, Shigetoshi; Sawada, Shozo; Yamamoto, Osamu; Sunayashiki, Tadashi; Yoshinaga, Haruma. Proc. Res. Inst. Nucl. Med. Biol., No. 8, 59-64(1967). (In Japanese).

The outline of a T(d,n) neutron generator, and the neutron dose penetrating the generator room are described. The dose measured by plastic scintillation method was much greater than the calculated dose based on the theoretical data of attenuation coefficient of fast neutron for ordinary concrete of which the room was constructed. However, there were no problems on the use of the generator provided the area around the facilities was carefully managed. Through the experience of the operation of the generator, the stability of neutron output and the quality of domestic and foreign tritium targets are discussed. (auth)

35180 PARTICLE BEAM FOCUSING MAGNET WITH A SEPTUM WALL. Lambertson, Glen R. (to United States Atomic Energy Commission). U. S. Patent 3,388,359. June 11, 1968.

A quadrupole electromagnet specifically designed for focusing a maximum number of secondary particles emitted in diverging paths from a target bombarded by the primary beam of a high energy particle accelerator is described. The compact physical structure of the magnet alleviates spatial congestion of the target region of the accelerator, in that one wall of the magnet contains a thin septum which allows the beam focusing field of the magnet to be disposed near the primary beam and the target without physically or magnetically interfering therewith. (AEC)

35181 ELECTRO-PHYSICAL APPARATUS. Elektrofiz. App., Sb. Statei, No. 6, 1-118(1967). (In Russian).

Articles on accelerators and their elements and auxiliaries are compiled. In particular, questions concerning sector magnets with heterogeneous poles, quadrupole lens, operation of linear electron accelerators, overvoltage in cascade generators, and dynamic of liquids in bubble chambers are examined. Methods of measurement with electrophysical devices and with magnetic measurement on electron synchrotrons using phase velocities were considered. The technological elements of the apparatus were examined in articles on the metalloceramic film compression and behavior of irradiated vitreous plastics. MHD conversion and special unipolar devices for MHD conversion were also considered. Questions on systems of electrical supply devices and their control with electrophysical devices were also discussed. (tr-auth)

35182 NEUTRON INELASTIC SCATTERING WITH THE WEST VIRGINIA UNIVERSITY ELECTROSTATIC ACCELERATOR. Errington, Paul R. Morgantown, W. Va., West Virginia Univ., 1966. 106p.

Thesis.

The design, installation and applications of the West Virginia University Van de Graaff electrostatic accelerator are discussed. Shielding and safety problems are described as well as their solutions. The use of the accelerator for both fast and thermal neutrons is examined. The inelastic scattering of neutrons from ^{56}Fe and ^{52}Cr is studied. The angular distributions of the .84 MeV gamma from the iron isotope and the 1.4 MeV gamma from the chromium isotope were measured. These were compared to a theoretical calculation based on the statistical model of the nucleus. The theoretical calculations were completed for neutron angular momentum values of 4, 5, and 6. An appendix which is intended to be a guide or manual for operation of the accelerator is presented. It is intended to be a supplement to the information provided by High Voltage Engineering Corporation. (Disser. Abstr.)

35183 PARTICLE-ACCELERATING DEVICE. Ichihara, Kooichi (to Kobe Industries Corp.). Japanese Patent 1967-24638. Nov. 27, 1967. Filed June 27, 1964.

In the particle-accelerating device proposed, which uses a Cockcroft Walton generator, a peculiar system is employed for supplying power and control signals to the electron gun or ion source. The advantages obtained are: a reduction in the space of installation and in the cost, the supplying of power to all sections of the ion source, and the control of all sections of the ion source from the low-voltage side. The high-voltage producing circuit consists of the usual arrangement of capacitors and rectifiers. A plurality of high-frequency power and of control signals, having frequencies higher than that of the high-voltage source and different from one another, are supplied from the low-voltage side, separate from the accelerating power source, to and through the series of capacitors. They are then taken from a transformer connected to the uppermost stage (of the Cockcroft-Walton generator), and then led to the corresponding wave filters. They are then supplied to the sections of the particle source. (NSA of Japan)

35184 DEVICE FOR OBSERVING AN ION BEAM PRODUCED IN CHARGED-PARTICLE ACCELERATORS. Kobayashi, Chiaki (to Japan Atomic Energy Research Inst.). Japanese Patent 1967-24637. Nov. 27, 1967. Filed Dec. 1, 1965.

By the method proposed, drawbacks to the conventional devices can be largely removed, including complication of the construction and operation, high cost, and instability of performance. It consists of the following: an evacuated duct (through which an ion beam passes); a probe; a rotating-disc device, which permits the beam scanning by the probe, which passes the beam at right angles, rotated by the disc; a device for taking out an electrical signal, produced by the crossing of the probe through the beam; a device for detecting the phase of rotation of the disc; and, a device for showing the position (in the duct) and the shape of an ion beam by means of the electrical signal and rotation phase. (NSA of Japan)

35185 EXPERIMENTAL STUDY OF THE TRANSITORY PHENOMENA PRODUCED IN THE INJECTION OF A NON-GROUPED PARTICLE BEAM IN AN ACCELERATING CAVITY WITH CIRCULAR IRIS. **Marcou, Jacques; Papiernik, Albert; Wartski, Louis (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 899-901(Apr. 1, 1968). (In French).**

The general aspect of the transitory phenomena is described, and the transitory regimes relative to the $2\pi/3$ ($V_\phi = 0.29$ c) mode are considered in particular. The amplitude a/(t) was studied as a function of the electron velocity and of the probe position. The comparison of the results obtained with previous results relative to the same cavity uncharged by a beam, but excited by a pulse-modulated high-frequency wave shows significant differences with respect to the evolution of the phase $\varphi(t)$, the effect of the frequency, and the propagation direction of the front of the transitory phenomenon. (J.S.R.)

35186 CONDITION FOR THE CORRECTION OF GEOMETRIC ABERRATIONS: APPLICATION TO 3RD-ORDER APERTURE ABERRATION OF STIGMATIC QUADRUPOLAR SYSTEMS. **Dhuicq, Daniel (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 906-8(Apr. 1, 1968). (In French).**

A method is presented which shows how, beginning with a general correction equation, the octopolar potentials permitting the correction of the 3rd order aperture aberration of 1st order stigmatic quadrupolar systems can be determined. The formulas obtained were applied to a particular case. (tr-auth)

35187 A LINEAR ACCELERATOR OF PROTONS WITH THE 2.5 MeV ENERGY ON THE H_{11n} WAVE. Kovpak, N. E.; Baranov, L. N.; Zeidlits, P. M. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 13: 552-5(Apr. 1968). (In Russian).

An accelerating system is designed and a laboratory device is made and started in the 2.5 MeV energy range having the accelerated proton current of 0.1 mA on the H_{11n}-type wave. The accelerating device length is 92 cm and the diameter is 30 cm. The H_{11n}-type wave accelerator has a number of advantages as compared with the E_{010}-type wave one: with the same electric field mean intensity the resonator length and the diameter decrease, the former—by a factor of two and the latter—by a factor of four; the high-frequency power need is also four times less. (auth)

35188 STRONG FOCUSING RING CYCLOTRON FOR MULTICHARGED IONS. **Dzhelepov, V. P.; Dmitrievskii, V. P.; Zamolodchikov, B. I.; Kol'ga, V. V. At. Energ. (USSR), 24: 323-6(Apr. 1968). (In Russian).**

The use of the strong focusing ring cyclotron for multicharged ions is considered. The cyclotron consists of the ring magnet system which provides strong focusing along two orthogonal axes and the isochronism of closed orbits, of the acceleration system (resonance cavities operating at constant frequency), of the accelerator-injector either of the Cockcroft-Walton type or of the transformer type. Such an accelerator can be successfully used for accelerating ions having the mass number $A > 40$ up to 6-10 MeV/nucleon. A variant of the cyclotron is considered permitting the secondary acceleration cycle. In this case energy per nucleon is increased $(z_2/z_1)^2$ times, where $z_2 - z_1$ is ion charge variation before the secondary cycle. The size of the ring area of the magnetic field is decreased several times. The calculations are given of two variants of the strong focusing accelerators, the maximum diameters being 10 and 4 m, respectively. The main advantages of the proposed accelerators are the following: the reduction of restrictions on the space charge, the absence of restrictions on the vacuum system, as well as the possibility of accelerating multicharged ions up to uranium in the continuous regime. (2 Tables, 2 figures, 6 references). (auth)

35189 COLLECTIVE LINEAR ACCELERATION OF IONS. **Veksler, V. I.; Sarantsev, V. P.; Bonch-Osmolovskii, A. G.; (and others). At. Energ. (USSR), 24: 317-23(Apr. 1968). (In Russian).**

A possibility of building an accelerator based on a new collective principle of acceleration (suggested by V. I. Veksler) is theoretically considered and proved by experiment. The methods of creation of a bunch with a large number of particles, its acceleration and supporting the stability of its size are considered. Certain conditions for the particle concentration as well as for the external electromagnetic fields, at which it is possible to obtain a bunch of an optimum size, are drawn from the calculations of the bunch stability. The experiments performed agree entirely with the calculation data. Consideration of different ways of supporting the bunch stability gives the possibility to choose the most effective and economically advantageous one, which is realized at the accelerator model. A choice of the accelerating system, for which the calculations of the effective electrical fields are made, is grounded. It is shown that these fields exceed considerably those obtained at present in the operating accelerators. (auth)

35190 KLYSTRONS FOR THE STANFORD LINEAR ACCELERATOR CENTER. **Merdinian, George K. (Varian Associates, San Carlos, Calif.); Lebacqz, Jean V.; Bierce, Richard W. IEEE (Inst. Elec. Electron. Eng.) Trans. Electron Devices, ED-14: 700-5(Oct. 1967).**

The 2-mile-long linear accelerator built at Stanford University uses 245 klystrons to produce an electron beam with an energy up to 20 GeV. In general, the klystrons are designed to produce a minimum of 21-MW peak power with extremely stringent phase and amplitude stability performance requirements. They are focused by permanent magnets and operate up to 250-kV beam voltage with a microperveance of 2. Gradual improvements in performance have been achieved by optimizing the bunching parameter and the output cavity coupling, and efficiencies approaching 45% were measured in a permanent magnet. Permanent magnet structure limitations, field shaping, and changes in the klystron design to reduce the magnetic field requirements are discussed. The output window life was improved by coating techniques developed to decrease single surface multipactor and reduce window operating temperature. Questions of coating stability are also discussed. Initial results of statistical analysis of tube life as a function of operating experience are also presented. (BBB)

35191 SUBHARMONIC ACCELERATION OF HEAVY IONS BY THE CYCLOTRON OF KYOTO UNIVERSITY. **Fukuzawa, Fumio; Imanishi, Nobutsugu; Sakisaka, Masakatsu; Yoshida, Koji; Uemura, Yoshiaki; Kakigi, Shigeru; Fujita, Hirokazu (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 363-78(Nov. 1967).**

Characteristics of subharmonic acceleration of heavy ions by the cyclotron of Kyoto University were investigated experimentally. About 100 nA of third-subharmonically accelerated C^{2+} and N^{3+} ion beams were extracted out of the cyclotron. Several kinds of ion beams corresponding to the fifth-subharmonic acceleration were observed by a probe inserted in the cyclotron. Energies and vertical spreads of these ion beams were estimated carefully to examine the possibility of the fifth-subharmonic acceleration. (auth)

35192 HIGH ENERGY LINEAR ELECTRON ACCELERATORS. **Rosatelli, Carlo (CNEN, Bologna). Alta Freq., 36: 488-93 (June 1967). (In Italian).**

A review of the main problems which occur in the development of a high energy electron linear accelerator is given. The discussion is based on the 20-GeV electron accelerator at Stanford; technological aspects of its construction and of the construction of other possible instruments by modification of existing ones are outlined. Specifications for the Stanford accelerator are given. (BBB)

35193 MAGNETIC PROBLEMS IN THE CONFIGURATION OF CYCLOTRON MAGNETIC FIELDS. **Boettger, Otto; Wolff, Wilhelm. Tech. Mitt. AEG-Telefunken, 58: 55-60(1968). (In German).**

The magnetic fluxes to be observed in the configuration of cyclotron magnetic fields are discussed. The specifications resulting on the various tolerances and the materials are derived. (tr-auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 33530, 35244, 35295, 35330, 35344–35346, 35349, 35364, 35697, 35699, 35722, and 35723.

35194 (AD–663369) ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY NEAR A TEMPERATURE DISCONTINUITY. Gritton, Eugene C.; Leonard, Anthony (RAND Corp., Santa Monica, Calif.). Dec. 1967. Contract F44620-67-C-0045. 79p. (RM–5300–PR). CFSTI.

An exact solution is obtained for the energy-dependent Boltzmann transport equation for thermal neutrons near a temperature discontinuity. The medium is nonabsorbing and infinite in extent. The method of solution consists of expanding the energy-transfer kernel in a degenerate form and then solving directly for the solutions of the resulting homogeneous equation. Both discrete and singular solutions are found. The angular flux is then expanded in terms of a complete set of these solutions. Finally, the expansion coefficients are determined by applying the boundary conditions associated with the temperature-discontinuity problem. Numerical calculations of both scalar neutron flux and total neutron density are included for various temperature ratios and neutron-to-moderator mass ratios. A comparison of the transport-theory results with diffusion-theory results shows that diffusion theory describes the neutron flux quite accurately for small values of temperature discontinuity. Diffusion-theory calculations become less accurate, however, as the higher energy modes become important. (auth) (USGRDR)

35195 (AEEW–M–802) U.K.A.E.A. NUCLEAR DATA LIBRARY, JANUARY 1967. Norton, D. S.; Story, J. S. (Atomic Energy Establishment, Winfrith (England)). Feb. 1968. 19p. Dep. CFSTI. UK 3s. 6d.

Details are given of the UKAEA Nuclear Data Library as of January 1967. The updating of the library included the incorporation of several new data files, together with the extension of ranges of some older files. (auth)

35196 (EIR–133) ENERGIEABHAENGIGE NEUTRONENVERZWEIGUNGSPROZESSE. (Energy Dependent Neutron Branching Processes). Waelti, P. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar. 1968. 43p. (In German). Dep.

A model was derived to describe the time development of neutron density in the energy space. The neutron transport was inserted into the formalism of the age-dependent branching process. In place of the Boltzmann equations, a simple regeneration equation is obtained. (J.S.R.)

35197 (GEAP–4953) HELM: A COMPUTER CODE TO CALCULATE MACROSCOPIC CROSS SECTIONS FOR THE PDQ-4 COMPUTER CODE. Nardi, A. J.; Sudborough, D. F.; Barth, J. J. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Oct. 1965. Contract AT(04-3)-540. 32p. Dep. CFSTI.

The computer program HELM, which calculates macroscopic cross sections that are compatible with the PDQ-4 diffusion code, is described. The program uses microscopic cross-section data from HELM cross-section file tapes; the output is available both in printed form and as cards punched in PDQ-4 format. (D.C.W.)

35198 (IN–1195) RESONANCE INTEGRALS MEASURED IN THE ADVANCED REACTIVITY MEASUREMENT FACILITIES. Topical Report. Scoville, J. J.; Rogers, J. W. (Idaho Nuclear Corp., Idaho Falls). June 1968. Contract AT(10-1)-1230. 15p. Dep. CFSTI.

The results of several years' effort of this laboratory in the measurement of resonance absorption integrals are disclosed. Although the results included have been previously reported in the open literature of the field, as has been the description of the various experimental techniques involved in these measurements, it was considered timely that all the results to date should be included in one document. References to the original publication of each resonance integral value are given. (auth)

35199 (LA-DC–9552) NUCLEAR SAFEGUARDS APPLICATIONS OF ^{252}Cf SPONTANEOUS FISSION NEUTRON SOURCES. Keepin, G. Robert (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 1p. (CONF-680434–1). Dep. CFSTI.

From AEC Transplutonium Program Committee Meeting, Washington, D. C.

The merits of ^{252}Cf spontaneous fission neutron sources for use in the nondestructive detection, identification, and analysis of fissionable materials on the basis of their delayed-neutron kinetic response, to fast-neutron irradiation are outlined. The sensitivity of the method for discrimination between fissionable isotopes is briefly discussed, and some possible source and detector configurations are indicated. (D.C.W.)

35200 (NBS-TN–283) NUCLEAR AND RADIATION STANDARDS OF IMPORTANCE TO THE NATIONAL ATOMIC ENERGY PROGRAM. Koch, H. W.; Donnert, H. J.; Havens, W. W. Jr.; Rogosa, G. L.; Rosen, L. (National Bureau of Standards, Washington, D. C.). Mar. 31, 1966. 44p. GPO $0.35.

A systematic approach to physical measurements in nuclear physics requires the establishment, availability, and use of standards. The standards of measurement may consist of standard cross sections, foils, counters, and evaluated nuclear data. Because of the fundamental importance of measurement standards, the Nuclear Cross Section Advisory Group has examined the definitions, requirements, characteristics, and availability of nuclear and radiation standards of importance to the national atomic energy program. (auth)

35201 (NYO–3326–22) THEORY OF SLOW NEUTRON INELASTIC SCATTERING BY LIQUIDS. Annual Progress Report, September 16, 1967–September 15, 1968. (Cornell Univ., Ithaca, N. Y. Dept. of Applied Physics). June 1968. Contract AT(30-1)-3326. 5p. Dep. CFSTI.

Advances in the research program during the period are summarized, together with the status of the various projects at the end of the reporting period. (D.C.W.)

35202 COMPLEMENTARY VARIATIONAL PRINCIPLES AND THEIR APPLICATION OF NEUTRON TRANSPORT PROBLEMS. Pomraning, G. C. (General Dynamics Corp., General Atomic Div., San Diego, Calif.). J. Math. Phys. (N. Y.), 8: 2096–2108 (Oct. 1967).

Several variational principles are developed which give upper and lower bounds for the linear functional (S,ψ), where ψ is the solution of the inhomogeneous equation $H\psi = S$ with H a self-adjoint, positive-definite, linear operator. Some of the principles bound this functional only with respect to small or local variations, whereas others give bounds for arbitrary variations. Several of the results obtained coincide with those of other authors widely scattered throughout the literature, and we show that these principles have a common origin. Other results given are new. Examples of the use of these principles are taken from the field of neutron transport theory, and both the linear Boltzmann or transport equation and the diffusion equation are used. One interesting result is that certain "exact" values of the extrapolated endpoint for the Milne problem, which have been reported in the literature, fall, due to numerical inaccuracies, outside the bounds computed here. (auth)

35203 ON THE CONVOLUTION APPROXIMATION IN THE THEORY OF COHERENT NEUTRON SCATTERING FROM LIQUIDS. Andriesse, C. D. (Reactor Instituut, Delft, Netherlands). Phys. Lett., 27A: 93–4(June 3, 1968).

A simple extension of the convolution approximation is proposed which gives a proper fit to quasi elastic neutron scattering from liquid argon. (auth)

35204 NEUTRON TUBE WITH THE PENNING ION SOURCE. Chrusciel, Edward; Starzec, Antoni (Inst. of Nuclear Engineering, Krakow). Przegl. Elektron., 8: 461-7(1967). (In Polish).

Fast neutrons are generated by the following (d,n) reactions: $T + d \rightarrow {}^4He + n + 14$ MeV; $D + d \rightarrow {}^3He + n + 2.5$ MeV; and $^7Li + d \rightarrow {}^8Be + n + 15$ MeV. Reaction cross sections for these reactions are tabulated, indicating also the design, construction and operation of the tubes in which they are carried out. The parameters which affect the ion jet include the deuteron pressure within the tube, the capacity of the ion source, the intensity and distribution of the magnetic field, and the cathode temperature. During the operation, the temperature of the individual elements of the tube increases, causing a reduction of the deuteron pressure, thus weakening the ion jet. A special container was designed to ensure a continued supply of deuterons. The deuteron consumption is presented graphically as a function of the temperature. The problem of the uniform distribution and transfer of heat was solved by an appropriate design of the receiving plate and the correct location of the electrodes. Measurements were carried out to determine production as a function of the energy of the deuteron jet. (TTT)

35205 PROTON DYNAMICS IN WATER AND ICE STUDIED BY INELASTIC SCATTERING OF SLOW NEUTRONS. Burgman, J. O. (Royal Inst. of Tech., Stockholm); Sciesinski, J.; Skoeld, K. Phys. Rev., 170: 808-5(June 15, 1968).

The proton dynamics of water at 273.4°K and ice at 268.7°K were studied by scattering of cold neutrons. It is shown that the sharp peaks in the ice spectrum are flattened out on melting and that the spectra from ice and water are thus significantly different. The main features of the spectra are rather independent of the scattering angle, and it is therefore concluded that multiphonon scattering cannot explain the divergency of earlier results on water close to the freezing point. (auth)

35206 CONCERNING THE NEUTRON RETHERMALIZATION IN A HEAVY GAS. Saastamoinen, J. (Univ. of Helsinki). J. Nucl. Ener., 22: 321-5(May 1968)

The transport theory solution for the energy moments of the angle-dependent flux is derived on the basis of the method proposed by Williams [Brit. J. Appl. Phys., 16: 1727 (1965)]. (UK)

35207 PULSED NEUTRON EXPERIMENTS IN NONMODERATING SYSTEMS. Helm, F. H. (Kernforschungszentrum, Karlsruhe, Ger.). Reactor Fuel-Process. Technol., 11: 72-83(Spring 1968).

A review of pulsed neutron experiments is presented in which the various pulsed neutron generators are briefly described and the status of theory and experiment is summarized. Reactivity measurements, spectral measurements, and cross-section measurements by prompt decay experiments are emphasized. 79 references. (D.C.W.)

35208 MEASUREMENT OF THE NEUTRON TEMPERATURE WITH LUTETIUM ISOTOPES. Lomakin, S. S.; Romanov, V. S.; Bochin, V. P. At. Energ. (USSR), 24: 389-91(Apr. 1968). (In Russian).

Measurement of the thermal-neutron temperature by the integral method is based on the determination of the cadmium ratio and of the relative reaction rates in absorbers. The findings of Wescott were applied for such measurements, using two 1-mm-thick and 10-mm-diameter ceramic discs containing ^{175}Lu and ^{176}Lu. The discs were prepared by compacting and firing at 1800°C mixture of aluminum and lutetium oxides. For calibration, these indicators were irradiated at 20°C in a graphite prism for 4 hours at a flux of 10^7 n/cm^{2}sec. In order to determine the neutron temperature in the prism at 170°C, the calibrated indicators, encapsulated in aluminum or cadmium, were exposed to a flux of 10^9 n/cm^2 sec for a few minutes. The cadmium ratio was found to be 2.82 and the ratio of the saturation activation of ^{176}Lu and ^{175}Lu was found to be 10.99 at an experimental error of less than 1%. From these data, the neutron temperature was calculated as $T = 150 \pm 15$°C. Thus, the measured neutron temperature was slightly below the temperature of the medium, probably because of distortions of the spectrum caused by the presence of materials used for fastening the indicator. (TTT)

35209 ASYMPTOTIC DISTRIBUTION OF NEUTRONS IN A MOVING MEDIUM. Kostritsa, A. A.; Neimotin, E. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 3-9(Nov.-Dec. 1967). (In Russian).

The solution of the neutron transfer equation during movement of heavy nuclei of the medium with velocity $\underline{\vec{u}}$ was examined. The cross section was assumed to be dependent on the relative velocity of the neutrons $\underline{\vec{v}}$ and of nuclei $\underline{\vec{u}}$. The attenuation length spectrum in the case $\Sigma_a \sim 1/y_R$ is significantly narrower than at Σ_a = const.; and the anisotropy of the angular distribution is significantly less. It was shown that the form of the spatial distribution of the neutrons satisfactorily agrees with the results of the solution of the one-velocity neutron transfer equation in which the motion of the medium is taken into consideration by the introduction of the convective term $\underline{\vec{u}}\Delta N$. (tr-auth)

35210 ANGULAR DISTRIBUTION OF NEUTRONS FROM PHILIPS NEUTRON GENERATOR PW 5300. Andresen, E. G. Messtechnik, 76: 81-3(Apr. 1968). (In German).

The angular distribution of fast neutrons emitted from the sealed-off neutron-tube of a commercial neutron generator shows the influence of self-absorption in the plane of the target, perpendicular to the axis of the tube. A remarkable absorption in the direction of the tube axis is caused by the high voltage-lead at the anode side, a smaller absorption by the cathode set-up on the opposite side. The influence of these absorptions reduces the total neutron yield by about 13%. (auth)

35211 CONTINUOUS MODEL FOR THE INELASTIC SLOWING-DOWN OF FAST NEUTRONS. Cadilhac, M. (Faculte des Sciences, Marseille, France); Pujol, Martine. pp 189-203 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Following up the preliminary studies on the approximate operator for inelastic scattering, its application to treatment of the inelastic slowing down of ^{239}Pu, either alone or associated with the elastic slowing down of oxygen, is studied. ^{239}Pu and oxygen are represented by their detailed microscopic cross sections. For pure ^{239}Pu, the errors introduced by using the continuous model are assessed from some significant parameters (direct spectra, slowing-down density, k_{eff}, etc.) and compared with the errors caused by transition to the classic multigroup convention. For the Pu/O$_2$ mixture, the validity of a joint model for the inelastic scattering of ^{239}Pu and the elastic scattering of oxygen in the inelastic slowing-down range is studied. In the same range, the conservation of the fine structure of the flux produced by oxygen scatter resonances is checked. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 33380, 35019, 35227, 35236, 35292, and 35410.

35212 POLARIZATION OF TRITONS SCATTERED FROM ^{4}He. Keaton, P. W. Jr.; Armstrong, D. D.; Veeser, L. R. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 20: 1392-5(June 10, 1968).

Absolute values for triton polarizations were measured for the first time. An analyzer is proposed for polarized tritons with energies of 7 MeV and higher. A scattered beam of 10-MeV tritons with a polarization of 88% from a cross section of greater than 600 mb/sr is reported. (auth)

35213 LEVEL STRUCTURE OF ^{4}H. Ziock, K.; Minehart, R.; Coulson, L.; Grubb, W. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 20: 1386-9(June 10, 1968).

A particle-unstable hydrogen isotope of mass 4 is formed in the reaction $\pi^- + {}^7\text{Li} \rightarrow {}^3\text{H} + {}^4\text{H}$. Two discrete levels of ^{4}H were found, and their binding energies and widths were determined. Some evidence for the existence of a third level is presented. (auth)

35214 THE TOTAL CAPTURE RATE OF NEGATIVE MUONS IN ^{4}He. Block, M. M. (Northwestern Univ., Evanston, Ill.); Kikuchi, T.; Koetke, D.; Sun, C. R.; Walker, R.; Culligan, G.; Telegdi, V. L.; Winston, R. Nuovo Cim., 55A: 501-6(June 1, 1968).

The total capture rate of negative muons in ^{4}He was measured by exposing the 20 cm liquid helium bubble chamber, operated in a 5 kG magnetic field, to a stopping muon beam. The measured capture rate is $(364 \pm 46)\text{s}^{-1}$. (auth)

35215 NEUTRON-NEUTRON ANGULAR CORRELATION IN THE REACTION ^{2}H(n,p)2n AT 14.1 MeV. Jeremie, H.; Miremadi, B. (Univ. of Montreal). Can. J. Phys., 46: 1132-5(May 1, 1968).

The angular correlation between the two outgoing neutrons in the reaction $n + d \rightarrow 2n + p$ was measured. One neutron counter was kept in a fixed position at 30° while the other was varied between 22.5 and 67.5°. A maximum in the number of counts was found for 42 ± 7°. A calculation according to the spectator model of Kuckes, Wilson, and Cooper (1961) does not reproduce the experimental results. (auth) (Canada)

35216 RETARDATION FUNCTIONS FOR DEUTERON PHOTODISINTEGRATION. Haemaelaeinen, R. M. K. (Univ., Jyvaeskylae, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, No. 266, 10p(Jan. 1968).

Different ways of generating the retardation functions are discussed. The retardation functions for the orbital magnetic dipole transitions and for the orbital electric dipole and quadrupole transitions are generated by using the simple semiclassical operator $-(e/\mu c)\, A \cdot p$. (auth)

35217 EXPERIMENTAL ASSEMBLY FOR THE STUDY OF THE PHOTODISINTEGRATION OF HELIUM AND OF THE PHOTOPROTON ENERGY SPECTRUM EMITTED BACKWARD BY VARIOUS ELEMENTS. Garfagnini, R.; Piragino, G.; Zanini, A. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur., 102: 311-26 (1967-68). (In Italian).

The experimental assembly developed for the study of the photodisintegration of helium is described. The assembly consists of a scattering chamber, in a magnetic field, charged with helium at 5 atm and exposed to the γ beam of the 100-MeV synchrotron. It is possible to carry out simultaneously the measurement of the energy and angular distributions of the photoprotons emitted backward by a target placed in the scattering chamber. The methods of analysis that were adopted and the results of the first measurements are described. (tr-auth)

35218 MAJORANA EXCHANGE FORCES AND PHOTO-DISINTEGRATION OF THE NUCLEUS ^{4}He. Dzhibuti, R. I.; Krupennikova, N. B.; Mamasakhlisov, V. I. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz., 7: 803-7(Apr. 1968). (In Russian).

Majorana exchange currents in the total cross section of the reactions ^{4}He(γ,p)^{3}H and ^{4}He(γ,np)D are investigated. It is shown that when using the Gauss functions (that provide correct values of binding energy and nuclei dimensions) as wave functions of the ground states of the lightest nuclei, the account of the Majorana exchange currents results in satisfactory explanation of experimental data. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 33380, 33822, 35018, 35213, 35261, 35285, 35293, 35313, 35362, and 35385.

35219 STUDY OF THE ^{6}Li(^{3}He,p$\alpha\alpha$) REACTION BELOW 2 MeV. Vignon, Bernard; Cavaignac, Jean-Francois; Longequeue, Jean-Pierre (Univ., Grenoble, France. CEN, Grenoble, France). Compt. Rend., Ser. A and B, 266: 878-81(Mar. 25, 1968). (In French).

The multiparametric study of the reaction ^{6}Li(^{3}He,p$\alpha\alpha$) below 2 MeV made evident the contribution of the 0^+ (ground), 2^+ (2.9 MeV), 4^+ (11.4 MeV), and 2^+ (16.6 and 16.9 MeV) states of ^{8}Be and the $3/2^-$ (ground) and $1/2^-$ (5 to 10 MeV) states of ^{5}Li. The positions and width of these levels were studied. (tr-auth)

35220 INELASTIC ELECTRON SCATTERING FROM ^{14}N BETWEEN 8.5- AND 11.5-MeV EXCITATION ENERGY. Clerc, H.-G.; Kuphal, E. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 211: 452-68(1968). (In German).

^{14}N was investigated by inelastic scattering of 35 ... 58 MeV electrons (scattering angles 117 to 165°). For the M1-transitions to the 2^+, T = 1 levels at 9.17 and 10.43 MeV, ground-state radiation widths of (7.7 ± 0.9) eV, and (12.1 ± 1.5) eV, respectively, were obtained. The ratio of these two widths is 1.57 ± 0.07. The 3^- T = 1 level at 8.90 MeV is excited by an M2-transition with $\Gamma_\gamma^0 = (6.6 \pm 2.2) \cdot 10^{-3}$ eV. An excitation of a level at (11.01 ± 0.07) MeV is observed. (auth)

35221 FORMATION CROSS SECTIONS OF FRAGMENTS WITH MASS ≥ 6 EMITTED IN REACTIONS INDUCED BY α PARTICLES OF 90 MeV IN C AND N TARGETS. Jung, Monique; Jacquot, Claude; Baixeras-Aiguabella, Carmen; Schmitt, Roger; Braun, Henri (Centre de Recherches Nucleaires, Strasbourg–Cronenbourg, France). Compt. Rend., Ser. A and B, 266: 815-16(Mar. 18, 1968). (In French).

The production cross sections of fragments with mass ≥ 6 emitted in the interactions of α particles with incident energy between 82 and 98 MeV with the C and N nuclei of the emulsion were studied. These cross sections were determined in view of the study of isotopic ratios proving of interest in astrophysics. (tr-auth)

35222 A ENERGY-LEVEL DOUBLET AT 9.16 MeV IN ^{15}N. Steerman, C. E.; Young, F. C. (Univ. of Maryland, College Park). Phys. Lett., 27B: 8-10(May 27, 1967).

Evidence is presented for the existence of an unresolved energy-level doublet at 9.16-MeV excitation in ^{15}N with separation between 2 and 8 keV. Branching ratios for γ decay of the individual members of the doublet have been determined. (auth)

35223 ON THE NUCLEAR SHAPE AND THE PHOTONEUTRON CROSS SECTION OF THE ^{19}F NUCLEUS. Baciu, G.; Catana, D.; Deberth, C.; Raileanu, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 385-91(1967).

The absolute cross section for the (γ,n) reaction on ^{19}F was measured by using the bremsstrahlung of the IFA betatron with a maximum energy of 25 MeV. The induced radioactivity in the samples of C_nF_{n+2} (teflon) was recorded by means of a γ-γ scintillation spectrometer. The data supplied by the spectrometer were recorded by a SA-40 type (Intertechnique) multichannel analyzer. The yield points were taken at 0.25 MeV intervals. The betatron energy scale stability was controlled at least two times per day and a deviation smaller than ±10 keV was observed. The calculated cross-section shows several discrete resonances; those disposed in the giant resonance region were well described by three Gaussians. The maxima occur at 15.10, 16.85, and 19.90 MeV. From the fine structure of the giant resonance the nucleus deformation parameters and the intrinsic quadrupole moment were calculated. They are: $\gamma = 12°$, $\beta = 0.18$, and $Q_0 = 0.125$ mbarns. (auth)

35224 USE OF THE CARBON RECOIL METHOD FOR THE ASYMMETRY MEASUREMENT OF NEUTRONS ELASTICALLY AND INELASTICALLY SCATTERED FROM CARBON. Mertens, Gerulf (Univ., Tuebingen, Ger.). Z. Phys., 212: 347-64(1968). (In German).

The carbon recoil method was used in a neutron time-of-flight spectrometer. The asymmetries of fast neutrons elastically and inelastically scattered from carbon nuclei in a plastic scintillator were measured simultaneously. Properties of the spectrometer are discussed. As an example the measurement of scattering asymmetries at $\theta_{lab} = 50°$, using 15.85-MeV neutrons from the d–t reaction, is described. (auth)

35225 MEASUREMENT OF THE ANGULAR DISTRIBUTION OF NEUTRON POLARIZATION FROM SCATTERING OF 15.85-MeV NEUTRONS BY CARBON. Mack, Guenther (Univ., Tuebingen, Ger.). Z. Phys., 212: 365-79(1968). (In German).

At $E_n = 15.85$ MeV, the angular distributions of neutron polarization P(θ) for ^{12}C(n,n)^{12}C and of scattering asymmetry A(θ) for ^{12}C(n,n′)^{12}C* (Q = −4.43 MeV) were measured. In a neutron time-of-flight method with a plastic scintillator as scatterer, carbon recoil nuclei were used for detection. Polarized neutrons were produced in the d–t reaction at $E_d = 1.90$ MeV at a reaction angle of 70° (lab.). With $P_n = -0.135$ scattering polarizations P(θ) are for θ_{lab} = 30, 40, 50, 60, 70, and 80° respectively −27.0 ± 2.1, −48.4 ± 2.7, −68.7 ± 3.6, −20.7 ± 6.2, +5.3 ± 3.9, and +2.1 ± 4.5%. (auth)

35226 ON COMPARISON OF THE ABSOLUTE VALUES OF CROSS SECTIONS FOR THE REACTIONS ^{12}C(π^-,π^-n)^{11}C AND ^{12}C(π^+,π^+n)^{11}C. Kolybasov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Lett., 27B: 3-4(May 27, 1968).

Calculation of the ratio of the ^{12}C(π^-,π^-n)^{11}C cross section to the summed cross section of the reactions ^{12}C(π^+,π^+n)^{11}C and ^{12}C(π^+,π^0p)^{11}C assuming the quasielastic character of these processes gave the value 1.5 ± 0.15 at the energy 200 MeV. (The experimental value is 1 but the errors seem to be large.) This result is of special interest in view of the identification of the reaction mechanism for the processes of the (π,πN) type. (auth)

35227 ENERGY AND ANGULAR DISTRIBUTIONS OF SECONDARY PHOTONS FROM THE INTERACTION OF A 6.2-GeV BREMSSTRAHLUNG BEAM WITH COMPLEX NUCLEI. Brandes, Juergen (Univ., Hamburg). Z. Phys., 212: 235-42(1968). (In German).

The energy spectra of secondary photons from the interaction of a 6.2-GeV bremsstrahlung beam with targets of H_2, Be, C, Al, and Cu are measured for laboratory angles from 35° to 120°. All spectra exhibit an exponential decrease of the photon yield with increasing momentum. Difference measurements with energies of the bremsstrahlung beam from 3.5 to 6.2 GeV for a center of mass angle of 90° are compared with the thermodynamical model of Fermi[2] and the reaction temperature is determined to be 83 MeV ± 8%. The results agree approximately with the measurements of p-Be-collisions at small laboratory angles. (auth)

35228 ANGULAR CORRELATION MEASUREMENT IN THE ^{11}B(d,pγ)^{12}B REACTION. Comsan, M. N. H.; Farouk, M. A.; El-Kamhawy, A. A.; El-Tahawy, M. S. M.; Lvov, A. N. (Atomic Energy Establishment, Cairo). Z. Phys., 212: 122-9(1968)

The p-γ angular correlations in ^{11}B(d,p)^{12}B reaction were measured in both reaction and azimuthal planes for proton angles 35° at $E_D = 1.60$ and 2.40 MeV. The correlation coefficient A_2^0 and the distortion parameter λ were calculated. The obtained values of the shift of the symmetry axis from the recoil direction, ϕ_0 and the parameter λ are far from their plane wave limits. The anisotropy of the angular correlation gives two possible values, 1^+ and 2^+, for the spin of the first excited state of ^{12}B. (auth)

35229 DISINTEGRATION OF ^{7}Li AND ^{6}Li BY 29.4-MeV ALPHA PARTICLES. Matsuki, Seishi (Kyoto Univ.). J. Phys. Soc. Jap., 24: 1203-23(June 1968).

The $^7\text{Li} + \alpha \rightarrow \alpha + \alpha + \text{t}$ and the $^6\text{Li} + \alpha \rightarrow \alpha + \alpha + \text{d}$ reactions were studied with 29.4-MeV alpha particles by detecting various pairs of final particles in coincidence. In the two-dimensional coincidence spectra, several resonances corresponding to the excited states of ^{7}Li, ^{6}Li, and ^{8}Be were observed. When the resonances overlap each other, enhancement of the cross section seems to occur. Decay correlations for the 4.63- and 6.56-MeV states of ^{7}Li and for the 2.18-MeV state of ^{6}Li were measured in and out of the reaction plane. Strong azimuthal anisotropy with respect to the direction of the recoil nucleus was found. DWBA calculations of the decay correlations are in fairly good agreement with the experimental results, and the spin-parities of the 4.63-MeV and the

6.56-MeV states of ^{7}Li are assigned to be $7/2^-$ and $5/2^-$, respectively. Slight difference between the yields of particles emitted in opposite directions in the rest frame of the 4.63-MeV state of ^{7}Li was found. The moment method analysis suggests that this difference is mainly due to the effect of the background non-resonant waves. (auth)

35230 ENERGY LEVELS OF LIGHT NUCLEI. VII. A = 11 to 12. Ajzenberg-Selove, F. (Haverford Coll., Pa.); Lauritsen, T. Nucl. Phys., A114: 1-142(1968).

A compilation of energy levels is given for A = 11−12 nuclei with emphasis on material leading to information about the structure of the A = 11−12 systems. (auth)

35231 EVEN- AND ODD-PARITY STATES IN ^{9}Be. Bouten, M.; Bouten, M. C.; Depuydt, H.; Schotsmans, L. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 27B: 61-4(June 10, 1968).

The results of a projected Hartree−Fock calculation are presented both for the even- and odd-parity states of ^{9}Be. It is found that the even-parity states come down very low in the energy spectrum and explain the occurrence of non-normal parity states at low energies. (auth)

35232 A STUDY OF DEUTERON-INDUCED REACTIONS IN FLUORINE AT BOMBARDING ENERGIES OF 2.0 AND 2.2 MeV. Bister, M.; Fontell, A.; Vikberg, P. (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 268, 16p(Feb. 1968).

Studies were made of the reactions ^{19}F(d,d)^{19}F and ^{19}F(d,α)^{17}O at bombarding energies of 2.0 and 2.2 MeV, and the reaction ^{19}F(d,p)^{20}F at 2.0 MeV. The absolute differential cross sections for elastic scattering, eight alpha groups, and two proton groups were measured with the aid of surface-barrier detectors, in a laboratory angle range of 30 to 163°. Legendre polynomial expansions were fitted to the alpha and proton angular distributions. Also a fit with the two-nucleon pick-up and heavy particle stripping theories was made for four alpha groups. The selection of reaction mechanism by fits is impossible. The strong angular dependence of alpha particle intensities indicates a large direct interaction contribution. With a heavy-particle spectrograph, it was found that one of the alpha groups measured included two alpha groups, which lead to the 5.70- and 5.73-MeV levels in ^{17}O. The energy difference between the levels was 34 ± 2 keV. Except in regard to the second excited state, the 2I + 1 rule gave quite a good fit, suggesting $3/2$ for the spin of the 5.22-MeV level in ^{17}O. (auth)

35233 ANALYSIS OF THE ^{19}F(p,α)^{16}O REACTION. Hird, B.; Li, T. Y. (Univ. of Manitoba, Winnipeg, Can.). Can. J. Phys., 46: 1273-89(June 1, 1968).

An attempt is made to fit quantitatively the ^{19}F(p,α)^{16}O ground-state angular distribution at an energy where direct processes are likely to predominate. The nuclear structures of this reaction favor the direct pickup process. The finite range effects were shown to be large. No unique fit, or choice between ambiguous input parameters, was found to be possible using two forms of the local-energy finite range correction. The overall magnitude was in good agreement with the theoretical spectroscopic factor, as calculated from both LS and jj coupling wave functions. (auth) (Canada)

35234 ANALYSIS OF THE SCATTERING OF 28-MeV DEUTERONS ON SOME NUCLEI CONTAINING EQUAL NUMBERS OF NEUTRONS AND PROTONS. Meyer, Jacques; Audebert, Bernard; Elbaz, Edgard; Lafoucriere, Joseph (Univ., Lyon). Compt. Rend., Ser. A and B, 266: 969-71(Apr. 1, 1968). (In French).

The angular distributions of the elastic scattering of 28-MeV deuterons on ^{10}B, ^{12}C, ^{14}N, ^{16}O, ^{20}Ne, ^{32}S, and ^{40}Ca were analyzed in the framework of the optical model. A coherent series of parameters were determined, giving a satisfactory agreement. (tr-auth)

35235 CORE POLARIZATION EFFECTS IN MASS 15 AND MASS 17. Shukla, Agam Prakash. Princeton, N. J., Princeton Univ., 1967. 145p.

Thesis.

The effects of residual interaction are investigated in (^{16}O ± 1 nucleon) nuclei. Wave functions of the $1/2^-$ and $3/2^-$ states of ^{15}O and ^{15}N are constructed by mixing the single hole spherical and (2p-3h) deformed configurations. The even-parity states of mass 15 are constructed by mixing the (1p-2h) and (3p-4h) deformed states. The Nilsson model is used for constructing the intrinsic states and the physical, deformed states (members of the rotational bands) are obtained by angular momentum projection. The effective charge for the E2 transitions among odd-parity states of mass 15 is calculated by taking account of the contribution of the 2^+ states of the ^{16}O core. An effective quadrupole−quadrupole force is used for the lowest 2^+ states while Hamada−Johnston realistic matrix elements are used to construct the T = 0 and T = 1 RPA vibrations. The eigenfunctions and eigenvalues thus obtained agree well with the previous calculations and the ^{16}O (γ,n)^{15}O and ^{16}O(e,e′)^{16}O scattering data. The (E2/M1) mixing ratio of the ($3/2^-$ 6 MeV → $1/2^-$ g.s.) transition in mass 15 is calculated. The phase of the calculated values agrees with experiment. The magnitude of x(E2/M1)^{15}O is in good agreement with experiment while the agreement for x(E2/M1)^{15}N is fair. It is found that 75% of the E2 amplitude of ^{15}O is due to the effective charge. In ^{15}N, the importance of the effective charge is not as large (~50% of the E2 amplitude). The ($3/2^-$ 6 MeV → $1/2^-$ g.s.) transition is found to be predominantly single hole M1 both in ^{15}O and ^{15}N. The electromagnetic decay of the 5-MeV doublet, 6.79-MeV $3/2^+$, 8.29-MeV $3/2^+$, and 8.74 MeV $1/2^+$ states of ^{15}O is also calculated. For the electric transitions the wave functions are treated as Hill−Wheeler integrals and a delta-function approximation is used. While for the magnetic multipoles M1 and M2, the Nilsson model is used. The transition amplitude is due to the odd particle with core effects accounted for, by using appropriate gyromagnetic ratios. The partial decay widths, lifetimes, and branching ratios for the above levels are calculated. Agreement with experiment is good. The ft value for the ^{15}O $\xrightarrow{\beta^+}$ ^{15}N ground-state decay is calculated. Comparison with experiment indicates that best agreement is obtained with a 10% deformed admixture in the ground state. The spectroscopic factors of the $1/2^-$ and $3/2^-$ states of mass 15, for single nucleon pickup reactions ^{16}O(p,d)^{15}O etc., are also calculated. Agreement with experiment is again good for 10% deformed admixture. From this, and the calculations of electromagnetic decay of the levels of mass 15, it is concluded that the ground state has a 10% deformed (2p-3h) component. Spectroscopic factors were also calculated for the odd-parity states of ^{17}O in the deuteron stripping reaction ^{16}O(d,p)^{17}O. It is concluded from this calculation and on the basis of previous work that the low-lying odd-parity states of ^{17}O are predominantly (2p-1h). The calculated spectroscopic factors are in poor agreement with measured values. Therefore, the relevance of the weak coupling model as an alternative to constructing these states, is discussed. (Disser. Abstr.)

35236 AN INVESTIGATION OF (p,d) REACTIONS IN 1p-SHELL NUCLEI. Kull, Lorenz Anthony. East Lansing, Mich., Michigan State Univ., 1967. 139p.

Thesis.

The energy levels of ^{5}Li, ^{6}Li, ^{8}Be, ^{9}B, and ^{10}B excited in the (p,d) reaction were studied with a 33.6-MeV incident proton beam from the Michigan State University sector-focused, isochronous cyclotron. The differential cross sections were measured for the strongly excited levels using a solid-state dE/dx counter telescope to detect the deuterons. The angular distributions were also measured for the elastic scattering of 33.6 MeV protons from ^{6}Li, ^{7}Li, ^{9}Be, and ^{10}B. Optical model fits were made with a computer code to this elastic proton data and to deuteron elastic scattering data obtained from the literature in order to extract optical parameters. These optical model parameters were used in a computer code which performed distorted-wave Born approximation (DWBA) calculations for the (p,d) reactions. The DWBA results were subsequently used to extract spectroscopic factors for all the strongly excited levels of the nuclei being studied. Deuteron groups were detected corresponding to strongly excited levels of ^{5}Li at 0.0 and 16.6 MeV excitation and to strongly excited levels of ^{6}Li at 0.0, 2.15, 3.57, and 5.38 MeV excitation. The energy spectra show deuteron groups corresponding to strongly excited levels of ^{8}Be at 0.0, 3.1, 11.4, 16.95, 17.62, 18.18, and 19.21 MeV excitation; a small deuteron yield was also observed corresponding to ^{8}Be excited levels at 16.6 and 19.15 MeV. Deuteron groups were observed corresponding to strongly excited levels of ^{9}B at 0.0, 2.35, 7.1, and 11.75 MeV excitation and to weakly excited ^{9}B levels at 2.8 and 14.6 MeV excitation. Deuteron groups were observed corresponding to strongly excited levels of ^{10}B at 0.0, 0.72, 1.76, 2.15, 3.57, 4.75, 5.18, and 6.04 MeV excitation; weakly excited levels were noted at 6.57 and 7.5 MeV excitation. The experimental spectroscopic factors were compared with several different theoretical calculations for the reactions being studied. In particular, good agreement was found between the data and an intermediate coupling model of the 1p-shell nuclei. On the basis of this general accord between experiment and theory, spin assignments were made for the observed ^{9}B levels from the intermediate coupling model predictions. Comparison of the experimental spectroscopic factors for the ^{10}B excited states with results from other experiments show that spectroscopic factors extracted by the present method do not depend significantly on the incident particle or its energy. Angular distributions for all the strongly excited levels observed, with the exception of the ^{8}Be level at 11.4 MeV ($J^\pi = 4^+$), indicate the direct pickup of a 1p shell neutron. Isotopic spin mixing in the higher excited levels of ^{8}Be and the possibility of 2s-1d shell admixtures in the ground state wave functions of the target nuclei are discussed. (Disser. Abstr.)

35237 THE USE OF A 40-IN. SCINTILLATION DETECTOR TO MEASURE (γ,n) AND (γ,2n) REACTIONS IN ^{19}F. Jones, Christopher Curtiss. Contract W-7405-eng-82. Ames, Iowa, Iowa State Univ., 1967. 214p. (IS-1678).

Thesis.

A high-efficiency neutron detector was used with the Iowa State University electron synchrotron to measure cross sections for the production of neutrons from fluorine at energies up to 50 MeV. The 250 gallons of liquid scintillator were viewed by 28 5-in. photomultiplier tubes. The efficiency as used was 55%. Production rates for reactions in which one or two neutrons were released were computed from a least squares analysis of the probability per beam pulse for observation of k counts, where k varied from zero to nine. Integrated cross sections up to 50 MeV were considerably less than the classical dipole sum, but were generally larger than previous results. The integrated cross section out to 50 MeV for processes in which one of two neutrons are produced is 218 ± 20 MeV-mb. (Disser. Abstr.)

35238 TEST OF DETAILED BALANCE IN THE REACTION ^{16}O(d,α)^{14}N AND ITS INVERSE. Thornton, Stephen Thomas. Knoxville, Tenn., Univ. of Tennessee, 1967. 106p.

Thesis.

A test of time reversal invariance was performed by measuring detailed balance in the reaction ^{16}O(d,α)^{14}N and its inverse. Experimental and theoretical interest in time reversal invariance was increased in 1964 by the discovery of CP violation in the decay of the K_2^0 meson. Assuming CPT invariance, then it appears that time reversal might also be violated. No direct experimental evidence has yet been given for a violation of time reversal invariance. Several proposals have been advanced to explain the observed CP violation. Of greatest interest to the present experiment is the suggested possibility of a small C and T violation in the strong interaction or a large violation of C and T invariance in the electromagnetic interaction. Either violation might cause the principle of detailed balance to be violated in reactions with strongly interacting particles. The reaction ^{16}O(d,α)^{14}N and its inverse were chosen for several reasons. First of all, at the bombarding energies available with the Oak Ridge National Laboratory 5.5-MeV Van de Graaff accelerator there are several open channels for these reactions. A compound-nucleus reaction with many open channels is expected to be sensitive to time reversal noninvariance. Secondly, both targets are gases of high natural isotopic purity, thus making them highly suitable for study with the precision gas scattering chamber. Absolute differential cross sections were measured at three different energies [E_{lab} (deuteron) = 4.41 MeV, 4.57 MeV, and 4.71 MeV] for both inverse reactions at cms scattering angles near 162°. Differential cross sections at backward angles were measured in order to limit interfering effects of reaction amplitudes. Detailed balance was determined to be obeyed at all three energies for the absolute differential cross section measurements. The standard deviations of the comparisons were ±0.6 percent. This represents a factor of ten improvement in sensitivity over any previous absolute cross section determination of detailed balance. Relative comparisons between the three measurements were also made and again detailed balance was obeyed to within the standard deviations of ±0.8 percent. Thus no violation of time reversal invariance was detected in the present experiment. (Disser. Abstr.)

35239 CROSS SECTIONS OF REACTIONS INDUCED BY 90-MeV α PARTICLES ON CARBON, NITROGEN, AND OXYGEN NUCLEI. Jacquot, Claude; Jung, Monique; Baixeras-Aiguabella, Carmen; Braun, Henri; Schmitt, Roger (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. A and B, 266: 963-5 (Apr. 1, 1968). (In French).

Emulsions (K0 and K5) were exposed to α beams with energies of 82 to 98 MeV. Preliminary results on the cross sections of the alpha reactions with ^{12}C, ^{14}N, and ^{16}O which were observed are presented. (D.C.W.)

35240 DIRECT REACTION ANALYSIS OF THE ^{11}B(p,α_0)^{8}Be REACTION. Warsh, K. L.; Edwards, S. (Florida State Univ., Tallahassee). Nuovo Cim., 55B: 443-50(June 11, 1968).

Seventy angular distributions of the ^{11}B(p,α_0)^{8}Be reaction over a 12-MeV range were analyzed using a plane-wave direct reaction theory incorporating pick-up and exchange pick-up (or heavy particle stripping) coherently mixed (PWBAE theory). The results of this analysis indicate that the reaction may proceed predominantly by a direct reaction mechanism. (auth)

35241 SHORT-RANGE DYNAMICAL CORRELATIONS IN THE ^{12}C NUCLEUS FROM ELASTIC ELECTRON SCATTERING. Ciofi Degli Atti, C. (Laboratorio di Fisica dell'Istituto Superiore di Sanita, Rome). Nuovo Cim., 55B: 570-4(June 11, 1968).

It is shown that if the elastic form factor is calculated using correlated wave functions, oscillator parameters similar to those given by the (e,e′p) reaction are obtained. (D.C.W.)

35242 ^{6}Li(γ,t)^{3}He AND ^{6}Li(γ,pd)^{3}H REACTIONS. Murakami, A. (Saga Univ., Japan). Nuovo Cim., 55B: 604-7(June 11, 1968).

The photodisintegration of ^{6}Li was investigated using nuclear emulsion loaded with 96.03% ^{6}Li, which was exposed to a 32-MeV bremsstrahlung beam. The cross sections for the reactions ^{6}Li(γ,t)^{3}He and ^{6}Li(γ,pd)^{3}H showed peaks at 21 and 24-25 MeV, respectively, with maximum values of 4.7 and 6 mb, respectively. The integrated cross sections up to 32 MeV were 12.4 ± 1.9 mb·MeV and 18.2 ± 2.0 mb·MeV, respectively. The angular distribution of tritons from the reaction ^{6}Li(γ,t)^{3}He shows a pronounced asymmetry around 90°, indicating interference between E1 and E2 absorption. (D.C.W.)

35243 IN-PILE MEASUREMENTS OF THE ENERGY RESPONSES OF TRITONS OBTAINED BY THE ^{6}Li(n,t)^{4}He REACTION AND DETECTED WITH SEMI-CONDUCTING DETECTORS. De Leeuw, Ghislaine; De Leeuw, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 277-88 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Neutron spectrum measurements by the ^{6}Li(n,t)^{4}He reaction, using either the parameter E_t or the parameter $E_\alpha + E_t$, call for knowledge of the distributions, characteristic for the spectrometer and the measurement medium, of the triton energies for monoenergetic neutrons. These distributions usually have to be calculated from the differential angular cross sections for triton emission at the neutron energies considered, when the angular distribution of the incidental flux is known. By determining these distributions experimentally in an isotropic neutron flux, one can check or complete the data for the differential angular cross-sections for triton emission. It is also shown that by making measurements with collimated detection geometry and comparing the results with those applicable to isotropic conditions, it is similarly possible, in the general case, to obtain an indication of the angular neutron-flux distribution, and to use this information for more precise interpretation of the spectra deduced from the parameters $E_\alpha + E_t$ and E_t. The energy distributions of tritons for neutrons with energies of about 250 keV was measured in the leakage spectrum of the HARMONIE reactor. This was done by using a single-channel analyzer to select a narrow-energy band in the $E_\alpha + E_t$ distribution measured and measuring the energy distribution of tritons coinciding with pulses from the single channel analyzer. The resolution of the neutron energy selected depends on the half-height width of the $E_\alpha + E_t$ response for thermal neutrons (90 keV for 30 μg of lithium fluoride) and the width of the single channel (40 keV). (auth)

35244 ANGULAR DISTRIBUTIONS OF THE RECOIL NUCLEI FROM THE REACTION ^{19}F(p,pn)^{18}F. Denisov, F. P.; Milovanov, V. P.; Pokrovskii, V. N.; Cherenkov, P. A.; Yutlandov, I. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 743-4 (Apr. 1968). (In Russian).

Angular distributions of the recoil nuclei from the reaction ^{19}F(p,pn)^{18}F at the incident proton energy 660 MeV were measured. The teflon targets were 1 mg/cm^2 thick. The angular distributions of ^{18}F have a maximum at angle of 80° in laboratory system. (auth)

35245 POLARIZATION OF DEUTERONS ELASTICALLY SCATTERED ON CARBON. Zaika, N. I.; Kibkalo, Yu. V.; Mokhnach, A. V.; Nemets, O. F.; Shmarin, P. L.; Yasnogorodskii, A. M. (Inst. of Physics, Kiev). Yadern. Fiz., 7: 754-7(Apr. 1968). (In Russian).

The polarization of 13.6-MeV deuterons scattered on carbon was studied by means of double scattering and from the asymmetry of the proton angular distribution in the ^{3}He(d,p)^{4}He reaction at the resonance energy 430 keV. The angular dependence of the vector polarization at the angles from 20 up to 54° cms was measured (it has a maximum at the angle of 35°, and changes sign at 40°). All components of the polarization are evaluated for the angle 25° in the lab system (the second-rank components are negligible). The values of the vector polarization obtained from the double scattering coincide within errors with the values obtained previously from the asymmetry of the proton angular distributions in the stripping reactions. (auth)

35246 INTERACTION OF THE IONS ^{6}Li AND ^{7}Li WITH LIGHT NUCLEI. Davydov, V. V.; Ogloblin, A. A.; Sakuta, S. B.; Chuev, V. I. Yadern. Fiz., 7: 758-69(Apr. 1968). (In Russian).

Energy spectra and angular distributions of tritons in the reaction ^{12}C(^{7}Li,t) and of α particles in the (^{6}Li,α) reactions on the nuclei ^{6}Li, ^{7}Li, ^{9}Be, and ^{12}C were investigated. The excitation of discrete levels was observed in the energy spectra. The angular distributions of α particles from the (^{6}Li,α) reaction were analyzed assuming the simplest mechanism of the deutron transfer to the target nucleus. (auth)

35247 NEUTRON POLARIZATION IN THE REACTION $^{14}N(d,n_0)^{15}O$ (GROUND STATE). Babenko, N. P.; Gridnev, K. A.; Nemilov, Yu. A. Yadern. Fiz., 7: 751-3(Apr. 1968). (In Russian).

Using the distorted-wave method, the neutron polarization from the reaction $^{14}N(d,n_0)^{15}O$ at the two values of deuteron energy (2.9 and 3.7 MeV) was calculated. It was shown that the distorted-wave theory qualitatively reproduced the angular dependence of the polarization. (auth)

35248 EXCITATION OF GIANT RESONANCE LEVELS OF ^{16}O IN ELECTRON SCATTERING. Kabachnik, N. M. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 7: 823-31(Apr. 1968). (In Russian).

Form factors and cross sections of electron scattering on the nucleus ^{16}O with the excitation of levels 1^- and 2^- lying in the giant resonance region are calculated. The calculation is made in the framework of the particle-hole model taking into account the continuous spectrum. It is shown that the application of the wave functions of continuous spectrum considerably changes (by 20 to 40%) the form factors both of longitudinal and transversal types. The results are compared with the experiment and with the calculation using the shell model with the oscillator potential. (auth)

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Refer also to abstracts 33380, 33822, 35182, 35227, 35234, 35285, 35292, 35293, 35313, 35314, 35321, 35335, 35338, 35362, and 35385.

35249 (AD-663112) ANGULAR DISTRIBUTIONS OF GAMMA RAYS FROM (n,n' GAMMA) INTERACTIONS OF 2.8-MeV NEUTRONS WITH SODIUM, MAGNESIUM, ALUMINUM, SULFUR, AND CHLORINE. Thompson, W. E.; Engesser, F. C.; Ferguson, J. M. (Naval Radiological Defense Lab., San Francisco, Calif.). Oct. 4, 1967. 40p. (USNRDL-TR-67-123). CFSTI.

The differential production cross sections for ten gamma rays resulting from the $(n,n'\gamma)$ reaction of 2.8-MeV neutrons with the nuclei of Na, Mg, Al, S, and Cl were measured. Although measurements of some of these cross sections at 90° have been reported previously, the newly acquired angular mobility of the neutron generator made possible the extension of these measurements to other angles. These resulting angular distributions were also calculated using Satchler's formalism adapted to Moldauer's modification of Hauser-Feshbach theory, using the transmission coefficients of Perey and Buck. Each distribution was calculated using two values of Moldauer's parameter Q. The theoretical variations with angle of the gamma-ray production cross sections is reproduced from the computer-output graphs. The present experimental results obtained at 90, 70, 55, and 31° are plotted on these graphs along with the results of others where they are available. (auth) (USGRDR)

35250 (INP-594/PL) STUDY OF THE (d,p) REACTION ON ^{48}Ti AND ^{50}Ti NUCLEI. Grotowski, K.; Jasielska, A.; Panek, T.; Pellegrini, F.; Wiktor, S. (Institute of Nuclear Physics, Krakow (Poland)). Mar. 1968. 24p. Dep.

Proton spectra from $^{48}Ti(d,p)^{49}Ti$ and $^{50}Ti(d,p)^{51}Ti$ reactions at the incident deuteron energy of 12.9 MeV were measured in wide range of angles. Six proton groups leading to ground, 1.38, 1.72, 2.50, 3.26, and 3.80 MeV states of the ^{49}Ti nucleus and two proton groups leading to ground and 1.16 MeV states of the ^{51}Ti nucleus were taken for the analysis of angular distributions. The distorted-wave, zero-range Born approximation method was applied; and the l-values, as well as spectroscopic factors corresponding to different transitions, were obtained. Four different sets of parameters of the deuteron optical potential were used in the DWBA analysis, and their influence on the shape of angular distributions and the magnitude of spectroscopic factors was investigated. Only these potentials which have the depth of the real potential not lower than about 100 MeV appeared to be acceptable. In the angular distributions measured, noticeable effects due to different coupling of spin and orbital angular momentum of the transferred neutron were observed. The differences in shapes of angular distributions caused by that effect were related to the polarization of protons scattered elastically on Ti nuclei. (auth)

35251 (NIJS-P-213) RADIATIVNO ZAJETJE NEVTRONOV ENERGIJE 14,1 MeV IN DIPOLNA VELERESONANCA. (Radiative Capture of 14.1-MeV Neutrons and the Dipole Giant Resonance). Hudoklin-Bozic, A. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Jan. 1968. 62p. (In Yugoslav). Dep.

The measurements of gamma-ray spectra from the radiative capture of 14.1-MeV neutrons by nuclei ^{28}Si and ^{40}Ca are described, and the results of these measurements are presented. The spectra show a certain gross structure similarly as the spectra of other nuclei measured previously in NIJS laboratories. For the integral cross section following values were obtained: $\sigma_{int,Si} = 0.44$ mb ± 0.09 mb and $\sigma_{int,Ca} = 0.50$ mb ± 0.10 mb. Both values follow a relatively smooth dependence of the integral cross section on the mass number obtained from earlier measurements. The calculation of gamma-ray spectra on the basis of three different approaches to the direct-semidirect theory proposed by Brown, by Lushnikov and Zaretsky and by Clement, Lane and Rook, supposing the formation of dipole resonance states in the reaction process, is described. The results of the calculation are given for target nuclei ^{28}Si, ^{32}S, ^{40}Ca, ^{52}Cr, and ^{56}Fe. The calculated spectra are compared with the experimental data. Besides, the spectra are also calculated according to the statistical theory. A comparison of calculated and measured data shows that the direct-semidirect theory describes reasonably well the gross structure of the measured spectra in the region of excitation energies between 0 and 5 MeV. An exception is the spectrum for calcium for which the calculation gives for about two times higher cross section than the experiment. The calculation according to all three models leads to similar shapes of the spectra. In the models of Brown and of Lushnikov and Zaretsky, the absolute values of the calculated and measured cross sections were compared. The last model gives better agreement with the experiment than the former one. In calculations on the basis of the model of Clement, Lane, and Rook, a value of 80 MeV for the parameter v_1 characterizing the strength of particle-vibration coupling was obtained by fitting the calculated cross section to the experimental data. In the excitation energy region above 5 MeV, the calculation according to the direct-semidirect theory gives for the cross section values which are much smaller than the experimental ones. In this energy region, the capture via formation of the compound nucleus accounts for an appreciable part of the transition strength. (auth)

35252 EVIDENCE FOR COLLECTIVE CORE EXCITATION IN THE LOW-LYING LEVELS OF ^{39}K. Lewis, M. B. (Univ. of Pittsburgh). Phys. Lett., 27B: 13-15(May 27, 1968).

Evidence due to inelastic deuteron scattering from ^{40}Ca and ^{39}K indicate that the 3.02-, 3.60-, 3.88-, and 4.12-MeV levels of ^{39}K are primarily the $3/2^-$, $9/2^-$, $7/2^-$, and $5/2^-$ respective members of the ^{40}Ca, 3^- (3.73 MeV), and $d_{3/2}$ proton hole multiplet. (auth)

35253 ASYMMETRY OF NEUTRONS FROM MUON CAPTURE IN SILICON, SULFUR, AND CALCIUM. Sundelin, R. M.; Edelstein, R. M.; Suzuki, A.; Takahashi, K. (Carnegie-Mellon Univ., Saxonburg, Pa.). Phys. Rev. Lett., 20: 1201-4(May 20, 1968).

The asymmetry in the angular distribution of neutrons emitted following the capture of negative muons in silicon, sulfur, and calcium was measured. The asymmetries, normalized to 100% muon polarization, varied from near zero for low neutron energies to +0.32 ± 0.05, +0.30 ± 0.08, and +0.20 ± 0.08 for energies greater than 15.6 MeV for silicon, sulfur, and calcium, respectively, in disagreement with the results of most other recent experiments. (auth)

35254 SPECTRUM OF NEUTRONS FROM MUON CAPTURE IN SILICON, SULFUR, AND CALCIUM. Sundelin, R. M.; Edelstein, R. M.; Suzuki, A.; Takahashi, K. (Carnegie-Mellon Univ., Saxonburg, Pa.). Phys. Rev. Lett., 20: 1198-1200(May 20, 1968).

The energy spectrum of neutrons emitted following the capture of negative muons in silicon, sulfur, and calcium was measured between 7.7 and 52.5 MeV. The spectra were found to decrease exponentially with energy in the three cases, and no evidence was found for excitation of giant dipole resonances. (auth)

35255 INTERNAL BREMSSTRAHLUNG FROM ^{51}Cr. Murty, Narasimha K.; Jnanananda, Swami (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 5: 557-64(Dec. 1967).

The high-energy part of the continuous spectrum of internal bremsstrahlung associated with the ground-to-ground transition and appearing as a low-intensity tail on the high-energy side of the 325-keV discrete γ-ray line of ^{51}Cr was studied in the energy region of 400 to 700 keV with a single-channel NaI(Tl) scintillation spectrometer along with a standard geometrical arrangement. Sufficient care was taken to avoid spurious effects and corrections made for several factors. Precautions were taken to minimize the random superposition of pulses resulting from the relatively more intense 325-keV discrete γ rays. A value of 794 ± 60 keV is obtained for the energy of disintegration. By using the theoretical expression of P. Morrison and L. Schiff (Phys. Rev., 58: 24 (1940)) for the intensity of the internal bremsstrahlung spectrum, a value of 8.3% is obtained for the percentage of disintegrations decaying to the 325-keV level of ^{51}V. These results are in good agreement with measurements made by independent methods. (auth)

35256 STUDY BY MEANS OF $^{18}O + \alpha$ OF THE EXCITED STATES BETWEEN 11.7 AND 13.0 MeV IN ^{22}Ne. Gorodetzky, S.; Port, M.; Graff, J.; Thirion, J. M.; Chouraqui, G. (Inst. de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 29: 271-8(Apr. 1968). (In French).

The $^{18}O(\alpha,\alpha)^{18}O$ elastic scattering and the competing reactions of the same system were investigated in order to determine the parameters of highly excited states in ^{22}Ne. Elastic scattering absolute cross sections were measured from $E_\alpha = 2.5$ to 5.0 MeV at $\theta_{C.M.} = 90.0$, 109.9, 125.3, 140.8, 149.4, and 167.0°. Excitation curves at $\theta_{C.M.} = 90.0°$ were measured for the $^{18}O(\alpha,n\gamma)^{21}Ne$ reaction between $E_\alpha = 2.5$ and 5.0 MeV and for $^{18}O(\alpha,\gamma_0)^{22}Ne$ between $E_\alpha = 2.5$ and 4.0 MeV. The radiative capture and inelastic scattering cross sections were found to be negligible compared with the (α,α) and (α,n) cross sections. This allowed the analysis of elastic scattering data to be made with a two-channel approximation in the energy range from $E_\alpha = 2.5$ to 4.0 MeV. Whenever it was necessary, the interference between levels having the same J^π was accounted for. Spins and parities could be assigned to 13 excited states in ^{22}Ne (E_x in MeV, J^π) 11.76, 1^-; 11.89, 1^-; 11.92, (2^+); 12.04, 0^+; 12.25, 0^+; 12.28, 1^-; 12.38, 2^+; 12.48, (2^+); 12.59, 1^-; 12.61, (2^+); 12.80, 2^+; 12.83, 1^-; and 12.88, 3^-. Seven of these are in agreement with previously reported results. (auth)

35257 THE $^{70}Ge(^3He,d)^{71}As$ REACTION. Broman, Lars; Rosner, Baruch (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A114: 237-40(1968).

A high-resolution study of the $^{70}Ge(^3He,d)^{71}As$ reaction was performed. Ten new states in ^{71}As were observed below 2.7-MeV excitation. The ground-state transition is characterized by $l_p = 3$ transfer and states at excitation energies of 0.15, 0.50, and 1.42 MeV by $l_p = 1$. The experimental transition strengths favor the assignments of $J^\pi = \frac{5}{2}^-$ and $\frac{3}{2}^-$ for the ground state and first excited state of ^{71}As, respectively. (auth)

35258 NEUTRON CROSS SECTIONS AND STRENGTH FUNCTIONS OF GERMANIUM ISOTOPES. Maletski, Kh.; Pikel'ner, L. B.; Salamatin, I. M.; Sharapov, E. I. At. Energ. (USSR), 24: 173-7(Feb. 1968). (In Russian).

Transmission, self-indication, and radiative capture of neutrons by Ge isotopes were measured using the IBR pulse reactor and a microtron. The level parameters in the energy range up to 30 keV for even isotopes and up to 9 keV for odd isotopes were determined. For two isotopes, the values of the strength functions, the mean distance between levels, and the mean radiative width were determined. (tr-auth)

35259 COULOMB MATRIX ELEMENTS FROM β-γ (CP) CORRELATION MEASUREMENTS IN ^{57}Ni AND ^{65}Ni. Atkinson, J. (Univ. of California, Livermore); Mann, L. G.; Tirsell, K. G.; Bloom, S. D. Nucl. Phys., A114: 143-60(1968).

Measurements of the β-γ(CP) correlation were made for the $\frac{3}{2}^-$ (β^+, 0.84 MeV) $\frac{3}{2}^-$ (γ, 1.38 MeV) $\frac{7}{2}^-$ (ground-state) cascade in the decay of ^{57}Ni and for the $\frac{5}{2}^-$ (β^-, 1.02 MeV) $\frac{5}{2}^-$(γ, 1.12 MeV) $\frac{3}{2}^-$ (ground-state) cascade in the decay of ^{65}Ni. The values obtained for the ^{57}Ni and ^{65}Ni asymmetry parameters are $A = +0.071 \pm 0.011$ and $A = +0.23 \pm 0.04$, respectively. The ^{57}Ni results verify the shell-model prediction of $\frac{3}{2}$ for the spin of the ^{57}Ni ground state. Thus, both cases are mixed β-transitions, and the measurements determine values for the Coulomb matrix elements connected with the Fermi part of the decays. The Coulomb matrix elements are 54 ± 10 keV for ^{57}Ni and 3.6 ± 5.7 keV for ^{65}Ni. A theoretical calculation in the case of ^{57}Ni indicates that the anti-analogue state is mixed to a small extent into the ground state of ^{57}Ni, which could account for the relatively large matrix element. The zero or near-zero matrix element in the case of ^{65}Ni is consistent with a vibrational-quantum number change of one in the β-decay to ^{65}Cu which corresponds to a difference in the same quantum number between the mixing states. (auth)

35260 GAMMA QUANTA ANGULAR DISTRIBUTIONS IN FAST NEUTRON INELASTIC SCATTERING ON THE NUCLEI Fe, Al, AND Cu. Turnov, N. N.; Gorshkov, O. N.; Nikolaev, O. A. (Gorky State Univ., USSR). Yadern. Fiz., 7: 748-50(Apr. 1968). (In Russian).

Differential cross sections of the γ emission in the inelastic scattering of 2.9-MeV neutrons on the nuclei ^{56}Fe, ^{27}Al, and $^{63,65}Cu$ are given for various excitation levels. The cross sections were measured by means of scintillation spectrometer in the ring geometry. (auth)

35261 EXAMINATION OF NUCLEAR REACTION WITH ~14-MeV NEUTRONS. Csikai, Gyula (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Foly., 16: 123-80(1968). (In Hungarian).

Clarification of fast neutron-induced reactions is complicated by the great scatter of the available experimental data and the absence of any results for a number of nuclei. Determination of the cross section of fast neutron reactions is of great importance for reactor physics, activation analysis, and isotope production. Experiments were therefore carried out with ~14-MeV neutrons to study (n,α), (n,p), $(n,2n)$, (n,f), and "rare" reactions. The various theories advanced in the literature to explain nuclear reactions were reviewed, examining the potential interactions between particles and nuclei, such as direct inelastic scattering, collective excitation, exchange reactions and capture reactions. In the first three cases which include knock-out, stripping, pick-up, and other types of reactions, the loss of degree of freedom is slight but the fourth case involves the creation of a metastable compound nucleus. The 14-MeV neutrons were produced by the $^3H(d,n)^4He$ reaction in a 100 and 300-keV neutron generator. The total reaction cross sections were determined by the activation method. The results obtained included the determination of the cross section of ^{14}N. The (n,p) cross section of this nuclide was found to be 77 ± 14 mbarn, and its (n,np) cross section was found to be 46 ± 13 mbarn. The experimental results of the cross sections of the (n,p) cross sections of ^{19}F, ^{23}Na, ^{27}Al, ^{42}Ca, ^{43}Ca, ^{44}Ca, ^{45}Sc, ^{89}Y, ^{139}La, ^{141}Pr, ^{188}Os, and ^{190}Os are shown in tabular form. Energy spectrum and angular correlation measurements carried out included a study of the $^{14}N(n,\alpha)^{11}B$ reaction and the $Zr(n,\alpha)Sr$ reaction. In addition, the fission of ^{238}U was also studied; the asymmetry factor of the angular distribution (W(0°)/W(90°) was found to be 1.43 ± 0.05, in agreement with earlier data. 166 references. (TTT)

35262 LIFETIMES AND DECAY MODES OF LOW-LYING LEVELS IN ^{26}Mg AND ^{26}Al. Haeusser, O.; Alexander, T. K.; Broude, C. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 1035-50(May 1, 1968).

Several bound states with excitation energy up to 7 MeV were studied in ^{26}Mg, using the $^{26}Mg(p,p'\gamma)$ reaction. The attenuated Doppler shift of the deexcitation gamma rays was observed with a Ge(Li) spectrometer. The extracted lifetime estimates and branching ratios for 15 excited states suggest that the rotational bands, built on different intrinsic states, are mixed considerably. Incidental information on lifetimes and decay properties of states in ^{26}Al is also presented. (auth) (Canada)

35263 THE LEVEL STRUCTURE OF ^{68}Zn. Hudson, F. R. (Univ. of Bradford, Eng.); Bampton, P. F.; Glover, R. N. Phys. Lett., 27B: 84-5(June 10, 1968).

The energies and spins of ^{68}Zn levels below 3-MeV excitation are determined from the reactions $^{66}Zn(t,p)$ and $^{68}Zn(p,p')$ and from the β decay of ^{68}Ga. (auth)

35264 EXCITED STATES OF ^{52}Cr POPULATED IN THE DECAY OF $^{52m,g}Mn$ AND ^{52}V. Pakkanen, Ahti (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 253, 37p(Oct. 1967).

Methods of singles, anti-Compton, double and multiple coincidence gamma spectroscopy were applied in study of the decay of 5.7-d ^{52}Mn, of 21-min ^{52m}Mn, and of 3.8-min ^{52}V, by means of Ge(Li) and NaI(Tl) detectors. Several new gamma transitions with low intensity were observed, and the following states in ^{52}Cr, not previously reported in these disintegrations, were found to be populated: the levels at 4.0149 and 3.1144 MeV in ^{52g}Mn decay, and the 3.1610- and 2.9642-MeV levels in the decay of ^{52m}Mn. The ground state of ^{52}V was confirmed to be 3^+. All the gamma transitions found in this work were placed in the proposed decay schemes. A comparison is made between the experimental level structure of ^{52}Cr and calculations from jj-coupling and collective vibrational models of different kinds. (auth)

35265 A STUDY OF THE PRODUCTION AND PROPERTIES OF $^{53}Fe^m$. Eskola, Kari (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 261, 45p(Nov. 1967).

An isomeric state with a half-life of 2.58 ± 0.03 min, and an excitation energy of 3.04 MeV, was discovered in ^{53}Fe. The following gamma rays were observed in its decay: 701.7 ± 0.2 keV (100%), 1011.1 ± 0.8 keV (84%), 1329.0 ± 0.8 keV (84%), and 2341.2 ± 1.2 keV (16%). A study of the decay properties of the isomer, and a comparison with theoretical shell model calculations, suggest that the isomeric state is a three-particle one with a spin of $\frac{19}{2}^-$. Cross sections, together with cross-section ratios of the isomeric pair of ^{53}Fe, were determined for the reactions $^{54}Fe(p,pn)^{53}Fe$, $^{55}Mn(p,3n)^{53}Fe$, $^{56}Fe(p,p3n)^{53}Fe$, $^{58}Ni(p,3p3n)^{53}Fe$, and $^{59}Co(p,2p5n)^{53}Fe$ for proton energies ranging from the reaction thresholds up to energies well above those corresponding to cross-section maxima. An analysis is presented of isomeric ratios in terms of the statistical theory of nuclear reactions. It is shown that the isomeric ratios calculated are markedly dependent upon the spin value assumed for the isomeric state. Close agreement exists between the calculated and experimental isomeric ratios if the isomeric state has a spin value of $\frac{19}{2}$. (auth)

35266 GAMMA-GAMMA CORRELATION IN ^{46}Ti. Gadzhokov, V.; Enchev, D.; Misheva, M.; Tumbaev, G. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1263-5 (1967). (In Russian).

The angular correlation function was measured for the 4^+(E2, 1.119 MeV) 2^+(E2, 0.887 MeV) 0^+ γ-ray cascade in ^{46}Ti, following the decay of ^{46}Sc. A 40-μCi ^{46}Sc source in a glass ampule was used for the measurements which were made at 10° intervals from 90 to 270° for the angles between the two scintillation detectors. The random coincidences were determined by three-min background counts; about 4.5×10^6 coincidences were recorded at each measured angle. The experimental results deviated slightly from the theoretically predicted correlation function. This is attributed to an M3 admixture in the E2 1.119-MeV transition. The results also indicated that the spin assignment for the 2.006-MeV state in ^{46}Ti can not be 3^+. (TTT)

35267 HALF-LIVES OF $s\frac{1}{2}$ AND $d\frac{3}{2}$ HOLE STATES IN ^{49}Sc. Chilosi, G.; Vingiani, G. B. (Univ., Naples). Phys. Lett., 27B: 81-3(June 10, 1968).

The half-lives of the 2.23- and 2.37-MeV levels in ^{49}Sc have been measured as 29.9 ± 1.1 and 1.40 ± 0.09 ns, respectively. Assignments of $J^\pi = \frac{1}{2}^+$ and $\frac{3}{2}^+$, respectively, are suggested. (auth)

35268 ANOMALOUS SPECTROSCOPIC FACTORS FOR ^{40}Ca (^{3}He,α)^{39}Ca AS COMPARED TO OTHER PICKUP REACTIONS ON Ca ISOTOPES. Lynen, U.; Santo, R.; Schmitt, D.; Stock, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 27B: 76-7(June 10, 1968).

The (p,d), (d,t) and (^{3}He,α) reactions on a mixed ^{40,42,44,48}Ca target were measured at $E_p = 19.5$ and 20 MeV, $E_d = 17$ MeV, and at ^{3}He energies between 14 and 28 MeV. All the strengths deduced from (p,d) and (d,t) agree with expectations, whereas the $d_{3/2}$ strength of ^{40}Ca obtained from (^{3}He,α) largely exceeds the sum rule limit and shows a strong energy dependence. A possible connection with the anomaly of elastic α scattering from ^{40}Ca is discussed. (auth)

35269 INFLUENCE OF THE INTERNAL ELECTRIC FIELD IN $BaTiO_3$ ON THE LIFETIME OF ^{89}Zr. Huber, P.; Gagneux, St.; Leuenberger, H. (Univ., Basel). Phys. Lett., 27B: 86-7 (June 10, 1968).

In the internal electric field of $BaTiO_3$, a change in the lifetime of ^{89}Zr was investigated. The measured relative change of the decay constant is $\Delta\lambda/\lambda = 4.4 \pm 0.4 \times 10^{-4}$. (auth)

35270 THE 4509-keV LEVEL IN ^{27}Al. Haeusser, O.; Pelte, D.; Sharpey-Schafer, J. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 46: 1145-52(May 15, 1968). (AECL-3080).

Levels in ^{27}Al below 4.6 MeV were studied by triple angular correlations. The 4509-keV level was found to have a probable spin value of $\frac{11}{2}$. The quadrupole/dipole mixing ratio for the 4509 → 3003 ($\frac{11}{2} = \frac{9}{2}$) transition was then found to be -0.58 ± 0.08. The value $J = \frac{9}{2}$ for the spin of the 3003-keV level was confirmed. Both levels are likely to belong to a rotational band with a predominant K value of $\frac{5}{2}$. (auth) (Canada)

35271 DECAY OF ^{40}Cl. Husain, L.; Karras, M. R. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem., 30: 685-9 (May 1968).

The decay of ^{40}Cl(1.4 min) to excited states in ^{40}Ar was studied with a lithium-drifted germanium detector and a NaI(Tl) detector. ^{40}Cl was produced through the ^{40}Ar(n,p)^{40}Cl reaction by irradiating liquid argon with 14.8-MeV neutrons. Singles and coincidence gamma spectra of separated and unseparated ^{40}Cl sources were obtained. The energies and relative photon intensities of the previously reported transitions of 6.0, 3.1, 2.85, 1.45, 0.65 MeV were measured. The energies and relative photon intensities of hitherto unreported transitions of 2.61, 2.18, 1.78, 1.43, and 0.33 MeV were also measured. A tentative decay scheme for ^{40}Cl is proposed. The beta branching to the 1.45-MeV level was also measured. (auth) (UK)

35272 NEUTRON PHOTOPRODUCTION CROSS SECTIONS FOR NICKEL AND SILVER. Fielder, Douglas Stratton. Charlottesville, Va., Univ. of Virginia, 1967. 93p.
Thesis.

The absolute (γ,n) cross sections of nickel and silver were measured using the bremsstrahlung from the 70-MeV electron synchrotron at the University of Virginia. The nickel and silver yield curves were measured from 10.25 to 25 MeV in 0.25-MeV increments and from 9 to 25 MeV in 0.5-MeV increments, respectively. The absolute measurements were made utilizing a Halpern type detection arrangement, a modified version of a type of ionization chamber designed at the National Bureau of Standards, and a Ra-Be source of known neutron flux. A minimum of 18 yield curves were measured for each element with an average standard error of less than 0.7% in the averaged yield curves. The data were analyzed using the least structure method developed by Cook for obtaining smoothed cross section results. The nickel yield was analyzed in 0.25-MeV bins and in two interlacing sets of 0.5-MeV bins. The silver yield was analyzed in 0.5-MeV bins. Results with optimum smoothing and slightly undersmoothed results were presented for each element. The least structure results gave the shape and magnitude of the cross section on the high energy side of the giant resonance peak. The silver cross section gave little evidence for discrete level structure. A comparison was made with the results of dynamic collective theory calculations by Greiner et al. The individual levels predicted by the theory were not seen although the positions of the giant resonance peak and the group of theoretical levels agreed. The nickel cross section showed evidence for several levels in addition to the main giant resonance peak and a boadening of the giant resonance on the high energy side of the main peak. The results of the dynamic collective theory given by Greiner et al., showed this broadening but did not predict any dipole strength below the main peak or above 22 MeV. The results of the theory of collective correlations given by Greiner et al., predict many more levels. Two of these levels on the low energy side of the main peak are at approximately the same energy as experimentally observed levels. The general distribution of levels above the main peak seems to be in fair agreement with the overall shape of the cross section curve. The agreement of theory and experiment seems better than with the dynamic collective theory. The absolute integrated cross sections were given. The silver integrated cross section nearly exhausts the dipole sum rule prediction. The natural nickel (68%^{58}Ni) integrated cross section exhausts only about 33% of the sum rule prediction. Previous measurements have shown the (γ,p) cross section ^{58}Ni to be considerably larger than the (γ,n) cross section. The low integrated cross section measured here seems to be in agreement with this.
(Disser. Abstr.)

35273 INELASTIC SCATTERING OF 40-MeV POLARIZED PROTONS. Fricke, Martin Paul. Minneapolis, Univ. of Minnesota, 1967. 144p.
Thesis.

The left-right asymmetry and differential cross section for the inelastic scattering of 40-MeV polarized protons were measured over a large angular region for each of the following 2^+ excitations: 1.78 MeV in ^{28}Si, 1.41 and 2.97 MeV in ^{54}Fe, 1.45 MeV in ^{58}Ni, and 1.33 MeV in ^{60}Ni. Some asymmetry and cross-section data were also obtained for 3^- states: 6.9 MeV in ^{28}Si, 4.8 and 6.4 MeV in ^{54}Fe, 4.5 MeV in ^{58}Ni, and 4.08 MeV in ^{60}Ni. Elastic polarization and cross-section data were obtained for each target. The inclastic scattering was analyzed in distorted-wave approximation using the collective-model extension of the optical-model potential determined by fitting the elastic scattering. The inelastic asymmetry and cross-section data are best reproduced with a collective-model interaction obtained by deforming the complete optical potential, including its imaginary and spin-orbit parts.
(Disser. Abstr.)

35274 AN INVESTIGATION OF THE (p.d) REACTION ON N = Z NUCLEI IN THE 2s-1d SHELL. Kozub, Raymond Lee. Ann Arbor, Mich., Univ., of Michigan, 1967. 194p.
Thesis.

An investigation of the (p,d) reaction on N = Z nuclei in the 2s-1d shell has been made to obtain spectroscopic information and to study the $l_n = 2$ J-dependence for the (p,d) reaction. The experiments were performed with ^{24}Mg, ^{28}Si, ^{32}S, ^{36}Ar, and ^{40}Ca as target nuclei. An enriched (>90%) ^{24}Mg target was used to study the ^{24}Mg(p,d)^{23}Mg reaction, and a natural SiO foil was used as a ^{28}Si target. Hydrogen sulfide and enriched (>99%) ^{36}Ar gas targets were used for the ^{32}S(p,d)^{31}S and ^{36}Ar(p,d)^{35}Ar experiments, respectively. The ^{40}Ca(p,d)^{39}Ca experiments were performed with evaporated foils of natural calcium. The 33.6-MeV protons were accelerated by the Michigan State University sector-focused cyclotron, and the deuterons were observed with (dE/dx)-E counter for telescopes. The overall deuteron energy resolution ranged from 95 keV for the ^{28}Si(p,d)^{27}Si reaction to 130 keV for the ^{36}Ar(p,d)^{35}Ar reaction. Virtually all of the 2s-1d shell hole strength was observed for each target studied. Deuteron angular distributions for strongly excited levels in ^{23}Mg, ^{27}Si, ^{31}S, ^{35}Ar, and ^{39}Ca were measured for laboratory angles from 10° to 155°. Excitation energies were also measured. The J-dependence for the pick-up of an $l_n = 2$ neutron appears mostly in the forward angles of the angular distributions and seems to follow a systematic trend through the 2s-1d shell. Unique spin assignments are suggested for levels in ^{31}Si, ^{35}Ar, and ^{39}Ca on this basis. There is some evidence for a correlation between the effects of J-dependence and the nature of the nuclear deformation. An attempt is made to reproduce J-dependence effects with calculations in the distorted-wave Born approximation. Configuration mixing is found to exist in the ground-state wave functions of all nuclei, and DWBA spectroscopic factors are extracted for the strongly excited levels. Of particular interest are the $l_n = 1$ levels excited in the ^{24}Mg(p,d)^{23}Mg and ^{28}Si(p,d)^{27}Si reactions, which could arise from either 1p or 2p pick-ups. The ground states of ^{36}Ar and ^{40}Ca are observed to contain appreciable mixing with the $f_{7/2}$ shell, and evidence exists for a small $[2p]^2$ admixture in the ^{40}Ca ground state. The level orders of the residual nuclei and the DWBA spectroscopic factors are compared to the strong coupling rotational model and to Nilsson model wave functions. Evidence for rotational band mixing is apparent in many cases. (Disser. Abstr.)

35275 EXCITATION FUNCTIONS AND YIELD RATIOS FOR THE ISOMERIC PAIR ^{80}Br ^{80m}Br FORMED IN (d,2n), (α,np), (α,p), AND (p,n) REACTIONS ON SELENIUM. Debuyst, R.; Vander Stricht, A. (Univ., Louvain, Belgium). J. Inorg. Nucl. Chem., 30: 691-8(May 1968).

Excitation functions were measured for the reactions ^{80}Se(d,2n)^{80,80m}Br and ^{82}Se(d,2n)^{82}Br at incident deuteron energies of 6.6 to 11.8 MeV; the reactions ^{77}Se(α,p)^{80,80m}Br, ^{78}Se(α,np)^{80,80m}Br, ^{80}Se(α,p)^{83}Br, ^{82}Se(α,2np)^{83}Br, and ^{80}Se(α,np)^{82}Br at incident α-particle energies of 9.6 to 24.3 MeV; and the reactions ^{80}Se(p,n)^{80,80m}Br and ^{82}Se(p,n)^{82}Br at incident proton energies of 2.5 to 6.0 MeV. The cross sections obtained are compared with Shapiro's and Igo's total cross-section calculations. The yield ratios obtained for the isomeric pair ^{80}Br – ^{80m}Br are discussed in terms of the spins of the levels involved, assuming compound-nucleus formations. (auth) (UK)

35276 FIRST EXCITED LEVELS OF ^{44}Ti OBSERVED IN THE (α,γ) REACTION ON ^{40}Ca. Vernotte, Jean; Langevin, Michel; Fortier, Simone (Institut de Physique Nucleaire, Orsay, France). Compt. Rend., Ser. A and B, 266: 972-4(Apr. 1, 1968). (In French)

The γ-ray spectrum from the deexcitation of the 9.11-MeV level of ^{44}Ti has at least four primary γ rays. Coincidence measurements make it possible to locate the first three excited levels of ^{44}Ti at 1.06 ± 0.02, 2.12 ± 0.04, and 2.42 ± 0.04 MeV. The results obtained are compared with theoretical results. (tr-auth)

35277 COMPARISON OF ENERGY LOSSES OF PROTONS AND DEUTERONS OF EXACTLY THE SAME VELOCITY. Ishiwari, Ryutaro (Nara Women's Univ., Japan); Shiomi, Naoko; Mori, Yuriko; Ohata, Tokiko; Uemura, Yoshiaki. Bull. Inst. Chem. Res., Kyoto Univ., 45: 379-87(Nov. 1967).

Energy losses of protons and deuterons of exactly the same velocity, of which the approximate energies are 7.27 MeV and 14.52 MeV, are compared in identical aluminum absorbers. The absolute values of the energy losses were measured with a broad range magnetic spectrograph. Within the experimental uncertainty of about 0.5 percent, the energy losses of protons and deuterons were found to be the same as theory predicts that they should be. The stopping powers for protons in aluminum were also determined. (auth)

35278 NEUTRON CAPTURE RESONANCE γ-RAY SCATTERING ON ZINC NUCLEI. Begzhanov, R. B.; Akhararov, S. M.; Mirvakhidov, M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 10, 25-7(1967). (In Russian).

The high-excitation state of Zn nuclei was studied using the method of resonance effect with a ^{207}Pb(n,γ) source. Gamma scattering spectra from Zn and Cu scattering sources at 7.38 MeV, recorded by a multichannel pulse analyzer, revealed a resonance effect of ~75%. The observed resonance was assigned to the even–even isotope ^{64}Zn(^{60}Zn or ^{68}Zn). The effective cross section $\langle\sigma_{pp}\rangle$ calculated assuming the dipole angular distribution was equal to (33 ± 4.5) mb at 7.38 MeV resonance in zinc. In the temperature range from 78 to 475°K, the peak divergence is $\delta = 9 \pm 15$ eV. (R.V.J.)

35279 EMISSION OF CHARGE Z ≥ 3 NUCLEI IN INTERACTIONS OF ANTIPROTONS AT 5.0 GeV/c WITH Ag AND Br NUCLEI. Baumann, G.; Gerber, J.-P.; Bechdolff, A.; Cueer, P. (Centre de Recherches Nucleaires, Strasbourg). Nuovo Cim., 55A: 656-66(June 21, 1968). (In French).

The production of fragments with Z ≥ 3 in 5.0 GeV/c antiproton interactions with Ag, Br nuclei is studied. The production data are in agreement with the evaporation theory, assuming the fireball model leading to an anisotropic expansion. (auth)

35280 AMOUNT OF ^{33}P IN ^{32}P SEPARATED FROM IRRADIATED SULFUR. Nakamura, Haruto. Nippon Genshiryoku Gakkaishi, 10: No. 4, 178-82(1968). (In Japanese).

It is difficult to avoid contamination by ^{33}P of ^{32}P products when ^{32}P is produced through the ^{32}S(n,p)^{32}P reaction. Three methods of studies in determining ^{33}P in ^{32}P product, and the results obtained are presented. The three methods are: β-ray absorption analysis by aluminum absorber; β-ray spectrum measurement by β-ray spectrometer, and decay curve analysis of β-ray activities. All these methods yielded satisfactory results which agreed well with each other. Among the three methods, the decay curve analysis technique was found to be the most convenient for simultaneously dealing with many samples of low activity, so that this method was used in determining the amounts of ^{33}P in ^{32}P separated from sulfur targets irradiated at different positions in JRR-3. The amounts of ^{33}P determined by the above method were about 2% when the sulfur targets were irradiated for 2 hr in the irradiation holes of the reactor tank with a high fast neutron flux, and were about the same as that of ^{32}P when irradiated for 2 hr in the radioisotope train with a low flux of fast neutron. The cross section for the ^{33}S(n,p)^{33}P reaction was also estimated and was found to be 4.5 ± 1.0 mb for thermal neutrons under this experimental condition. (auth)

35281 MEASUREMENT OF CROSS SECTION OF THE REACTION ^{54}Fe(n,2n)^{53}Fe. Andreev, M. F.; Serov, V. I. Yadern. Fiz., 7: 745-7(Apr. 1968). (In Russian).

In the 13.9 to 17.4 MeV neutron energy region, the excitation functions of the reactions ^{54}Fe(n,2n)^{53}Fe and ^{63}Cu(n,2n)^{62}Cu were measured. The cross section of the reaction ^{54}Fe(n,2n) is obtained. The experimental data are compared with the calculations based on the statistical theory of nuclear reactions. (auth)

35282 DOUBLE-ANALOG RESONANCES IN THE REACTIONS ^{58}Ni(pn)^{58}Cu. Guzhovskii, B. Ya.; Borkin, I. M.; Zvenigorodskii, A. G.; Rudnev, V. S.; Solodovnikov, A. P.; Trusillo, S. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1679-85(Oct. 1967). (In Russian).

Studies of resonance structure of the excitation function of ^{58}Ni(p,n)^{58}Cu reaction at the energy range 9.5 to 10.6 MeV in the presence of double analog resonances showed the existence of strong isolated resonances (Γ ≈ 20 keV, D ≈ 40 keV) at an excited nucleus energy ^{58}Cu ~13 MeV. In this state with T = ½, the Γ ≫ D and Γ ≈ 1 keV are completely overlapped. Therefore, it was assumed that the resonance structure corresponds to the analog excitations (Γ < D ≈ 30 keV) and double-analog (Γ ≪ D ≈ 180 keV) states. The analysis of the intermediate structure as double-analog and analog states contradicts the concept of K. Izumo and is close to the H. Feshbach doorway state model (Ann. of Phys., 19: 287 (1962)). At the present time the analog and double analog resonances are the only examples of the intermediate states. (R.V.J.)

35283 GAMMA EMISSION FROM ^{81}Rb, ^{82*}Rb, ^{82}Rb, ^{83}Rb, ^{84}Rb, AND ^{86}Rb. Vrzal, Ya., Dzhelepov, B. S.; Dmitriev, A. G.; Zhukovskii, N. N.; Liptak, Ya.; Moskvin, L. N.; Urbanets, Ya.; Tsaritsyna, L. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1661-71 (Oct. 1967). (In Russian).

The isotopes ^{81}Rb($T_{1/2}$ = 4.7 hr), ^{82}Rb(6.3 hr), ^{82}Rb(1.3 min), ^{83}Rb(83 days), ^{84}Rb(33 days), and ^{86}Rb(18.7 days) were separated from strontium and yttrium target irradiated by 660-MeV protons. Coaxial Ge(Li) detectors were used for measuring γ spectra of the above isotopes at 16.5, 26, and 43 hr and 2.5 and 8 days after irradiation. Gamma spectra of the rubidium fraction 43 hr after preparation of the source were observed. The energy and relative γ-ray intensities of the isotopes were obtained. Relative yields of the rubidium isotopes from the yttrium target are tabulated. The data obtained were used to construct a decay scheme for ^{82*}Rb and ^{82}Rb. (R.V.J.)

35284 DECAY OF ^{70}As, ^{71}As, AND ^{72}As. Vitman, V. D.; Vrzal, Ya.; Dzhelepov, B. S.; Liptak, Ya.; Medvedev, A. I.; Moskvin, L. N.; Urbanets, Ya.; Tsaritsyna, L. G. (All-Union Scientific-Research Inst. of Metrology, Leningrad. Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1623-32(Oct. 1967). (In Russian).

Gamma spectra of neutron-deficient isotopes produced in the spallation of Sr and Y by 660-MeV protons were investigated using a Ge(Li) spectrometer. Decay schemes are proposed for ^{70}As, ^{71}As, ^{72}As, and ^{72}Ga. (R.V.J.)

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Refer also to abstracts 33208, 33380, 33822, 35261, 35272, 35279, 35365, 35387, 35408, 35411, and 35737.

35285 (AERE-PR/NP-13) NUCLEAR PHYSICS DIVISION PROGRESS REPORT FOR THE PERIOD MAY 1–OCTOBER 31, 1967. Coleman, C. F. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Feb. 1968. 69p. Dep. CFSTI. UK.

Research dealing with nuclear data for reactors, nuclear structure and dynamics, radiation detectors, accelerator technology, Moessbauer applications, and astrophysics is summarized. (D.C.W.)

35286 (ANL-Trans-611) ANGULAR ANISOTROPY AND MASS ASYMMETRY OF ^{232}Th FISSION FRAGMENTS. Kuz'minov, B. D.; Sergachev, A. I. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 611-17 of STI/PUB-101 (Vol.1), Presented at Proceedings of Symposium on Physics and Chemistry of Fission, Salzburg, March 22-26, 1965. 8p. Dep. CFSTI.

The angular anisotropy of fragments with different masses in the fission of thorium-232 by fast neutrons was investigated. The masses of the fragments were determined by simultaneous recording of the kinetic energy of paired fragments in a double ionization chamber with grids. The direction of flight of the fragments was determined using a mechanical collimator. The neutrons causing fission had an extended spectrum, but the contribution of fissions via the (n,n′f) reaction did not exceed a few percent. The fragments were sorted out according to energy by a two-dimensional 128 × 128 channel analyzer with a memory on ferrite. The dependence of angular anisotropy on the mass of the fragments and on their kinetic energy with fixed mass is discussed. The first dependence makes it possible to judge the degree to which the saddle point affects the distribution of the fragments according to mass, while the second gives information about the degree to which the configuration of the nucleus at the moment of breakdown affects the angular anisotropy of the fragments. (auth)

35287 (BNL-tr-215) LOWER EXCITED STATES OF ^{182}Ta. Alksnis, Ya. K.; Balodis, M. K.; Prokof'ev, P. T. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Preprint. 11p. Dep. CFSTI.

The spectrum of conversion electrons emitted during the reaction ^{181}Ta(n,γ)^{182}Ta was measured using a β spectrograph with a resolution of 0.1 to 0.3%. The energies and relative intensities of the electron groups were determined. The lack of data on the intensities of γ rays allowed multipolarity assignments to be made only for the 133.1-, 171.5-, and 268.3-keV transitions in ^{182}Ta. Spin-parity assignments were made for a few levels in ^{182}Ta. A level scheme is proposed for ^{182}Ta. (D.C.W.)

35288 (BNWL-774) PCTR INTEGRAL MEASUREMENTS OF ^{239}Pu ALPHA ($\overline{\alpha}$) IN FAST SPECTRA. Lanning, D. D.; Busselman, G. J.; Bennett, C. L.; Newman, D. F.; Bierman, S. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 15, 1968. Contract AT(45-1)-1830. 42p. Dep. CFSTI.

An analysis of the feasibility of integral measurements of $\overline{\alpha}$ for ^{239}Pu in the Physical Constants Test Reactor (PCTR) as a function of the carbon-to-uranium ratio in plutonium oxide-uranium oxide-carbon mixtures is summarized. The experiments proposed will use 8 to 14% PuO_2 (of low ^{240}Pu) in UO_2 mixed with graphite. It is concluded that integral values of $\overline{\alpha}$ for ^{239}Pu can be measured in the PCTR with an uncertainty less than ±0.06. (D.C.W.)

35289 (DP-MS-67-14) MOESSBAUER EFFECT IN ^{147}Pm. Croft, W. L.; Stone, J. A.; Pillinger, W. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 4, 1967. Contract AT(07-2)-1. 10p. (CONF-670414-8). Dep. CFSTI.

From Meeting of the American Physical Society, Washington, D. C.

The Moessbauer effect was observed with the 91-keV gamma ray in ^{147}Pm, which has a half-life of 2.62 yr. ^{147}Nd sources were prepared by thermal neutron irradiation of $^{146}Nd_2O_3$. Moessbauer velocity spectra were obtained with a time-mode spectrometer of the Kankeleit type for nine ^{147}Pm compounds at 4.2°K. Single absorption lines were observed in each compound; no isomer shift was observed for any of the compounds within the experimental accuracy. (D.C.W.)

35290 (JINR-P7-3808) EKSPERIMENTY PO POISKU α-RADIOAKTIVNYKH IZOTOPOV 105 ELEMENTA. (Experiments on Search for α-Radioactive Isotopes of Element (105). Flerov, G. N.; Druin, V. A.; Demin, A. G.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 16p. (In Russian). Dep.

Experiments in the search for the α-emitting isotopes of element 105 are described. The short-lived α emitters with α-particle energies of 9.4 and 9.7 MeV were synthesized by bombarding ^{243}Am with the ^{22}Ne ions. It is shown that by its decay α emitters are produced, the properties of which are similar to those of the ^{256,257}103 isotopes. A preliminary conclusion was drawn that 9.4- and 9.7-MeV α emitters are the element-105 isotopes. (auth)

35291 (LA-DC-9586) STATE MIXING IN ^{165}Ho. Bunker, M. E.; Berzins, G.; Starner, J. W. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 1p. (CONF-680702-2). Dep. CFSTI.

From International Symposium on Nuclear Structure, Dubna, USSR.

An explanation of some disagreement between theoretical predictions, based on the Nilsson model with inclusion of pairing and quasiparticle-phonon residual interactions, and experimental information, based on γ spectroscopic studies of the decay of ^{165}Dy and ^{165m}Dy, on the level structure of ^{165}Ho is outlined. (D.C.W.)

35292 (ORNL-4217, pp 1-81) EXPERIMENTAL NUCLEAR PHYSICS. (Oak Ridge National Lab., Tenn.).

The experimental nuclear physics program includes spectroscopy of various nuclei from ^{3}He to ^{209}Bi by means of transfer reactions or inelastic scattering with various projectiles. The regions of the periodic table investigated were: the s-d shell, the mass 90 region, some nuclei in the $N = 82$ and some in the $Z = 50$ region, and ^{209}Bi. New results are also presented on proton-proton bremsstrahlung, on two-nucleon final-state interactions, and on the proton spin flip in inelastic scattering. The decay of ^{182}Os and ^{154}Ho was investigated, and two new neptunium isotopes, ^{229}Np and ^{230}Np, were identified. (auth)

35293 (ORNL-4230) PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1967. Stelson, P. H. (ed.) (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 149p. Dep. CFSTI.

The energy levels of several medium-weight and heavy nuclei were investigated using thermal neutron capture and charged-particle reactions and scattering. Shell-model calculations were performed for sd-shell nuclei with $A = 18$ to 22 and for ^{56}Cr and ^{58}Fe. Nonlocal deuteron and α-particle optical potentials were constructed, and the effects of including exchange amplitudes of the knock-on type in the microscopic description of inelastic scattering were studied. Infrared evidence for $Pb^{2+}CN^-$ pair formation in alkali halide lattices was obtained, and vibrational frequencies of diatomic ions in alkali halide solid solutions were determined. The Zeeman effect in Er I and II and the Lamb shift of one-electron heavy ions were investigated. The magnetic moment of the 67-4-keV state in ^{61}Ni was determined through Moessbauer observations. Differential cross sections for the reaction $^{16}O(d,\alpha)^{14}N$ and its inverse were measured in an attempt to test time reversal invariance through detailed balance. Fission-fragment energy-correlation measurements were made in the fission of ^{233}U, ^{235}U, and ^{238}U by 7- to 13-MeV protons and in the thermal neutron fission of ^{233}U. An indirect measurement of neutron emission in proton-induced fission of ^{233}U was also made. The stability of very elongated nuclei with high angular momenta was studied theoretically. The neutron total cross section of ^{16}O was measured from 1.1 to 3.7 MeV. The exchange mechanism in the interaction $p + n \rightarrow \Delta^{++} + \Delta^-$ was also investigated. (D.C.W.)

35294 (PUC-937-321) THE SPINS AND MOMENTS OF ^{110}In AND ^{112}In. Casserberg, Bo R. (Princeton Univ., N. J. Palmer Physical Lab.). May 1968. Contract AT(30-1)-937. 103p. Dep. CFSTI.

Thesis.

The spins and hyperfine interaction constants of ^{110}In (66 min.) and ^{112}In (14 min.) in the $^2P_{1/2}$ atomic state were measured by atomic beam magnetic resonance techniques. The isotopes were produced by bombardment of natural cadmium by 17.5-MeV protons in the Princeton cyclotron. A new, simple, and rapid method of separating the radioactive indium from the cadmium was devised. Stable indium carrier was added to the irradiated cadmium in the beam apparatus oven; and the cadmium was evaporated, leaving the radioactive indium with the stable carrier. The temperature was then raised to the proper one for atomic beam production, and beam collection could begin 15 min after the cyclotron bombardment. The magnetic resonance measurements gave the following results: ^{110}In: $I = 2$, $A = 429.20\ (36)$ MHz, $B = 192.5(7)$ MHz, $g_J = -1.33411(6)$. ^{112}In: $I = 1$, $A = 554(4)$ MHz, $B = 48.3(25)$ MHz. The hyperfine interaction constants give the following values for the nuclear moments: ^{110}In: $\mu = 4.360(4)\mu_N$, $Q = 0.34(2) \cdot 10^{-24}\ cm^2$; and ^{112}In: $\mu = 2.81(3)\mu_N$, $Q = 0.086(5) \cdot 10^{-24}\ cm^2$. The perturbations of the $^2P_{1/2}$ hyperfine levels caused by the nearby $^2P_{3/2}$ state were considered. (auth)

35295 (TPM-RFR-682) ^{239}Pu EVALUATIONS. Wallin, Marie (Aktiebolaget Atomenergi, [Studsvik] (Sweden)). Dec. 7, 1967. 11p. Dep.

The updating of the Speng library for ^{239}Pu to reflect recent measurements and evaluations of the cross sections and resonance parameters for ^{239}Pu is discussed. (D.C.W.)

35296 (UCRL-50421) PHOTONEUTRON CROSS SECTIONS OF POLARIZED ^{165}Ho. Kelly, Michael A. (California Univ., Livermore. Lawrence Radiation Lab.). May 1, 1968. 87p. Dep. CFSTI.

Thesis.

The (γ,n) and (γ,2n) cross sections of polarized ^{165}Ho were measured between 10 and 20 MeV using the nearly monoenergetic photon beam from the Livermore linear accelerator. Two independent cross sections were obtained by orienting the polarization axis perpendicular to and parallel to the photon beam direction. From these, the cross sections corresponding to the intrinsic modes of the giant resonance are computed. The target consisted of nine single crystals of holmium metal, having a total mass of 50 g and was polarized by cooling to approximately 0.13°K in the presence of the 15-kOe field. The alignment parameter f_2 was determined to be 0.43 ± 0.05 by measuring the anisotropy of the gamma rays emitted by ^{166m}Ho (created in the target by neutron activation). The total photoneutron cross section, $\sigma_t = \sigma(\gamma,n) + \sigma(\gamma, 2n) + \sigma(\gamma, np)$, exhibited an anisotropy in both major peaks of the giant resonance that agrees qualitatively with the collective model for deformed nuclei. An elementary version of the collective model and the dynamic collective model predict an anisotropy 22 to 26% larger than was observed. (auth)

35297 CONFIGURATIONS OF THE LOWEST 4^- STATE IN ^{208}Pb. Bondorf, J. P.; Von Brentano, P.; Richard, P. (Univ. of Washington, Seattle). Phys. Lett., 37B: 5-7(May 27, 1968).

From an analysis of the angular distribution of the reaction ^{208}Pb(p,p')^{208}Pb (3.469 MeV) measured on top of the $g_{9/2}$ analog resonance in ^{209}Bi, a wave function was obtained for the 4^- (3.469 MeV) state in ^{208}Pb. $|4\rangle = +(0.96 \pm 0.02|(p_{1/2}^{-1}g_{9/2})4\rangle - (0.26 \pm 0.03)|(p_{3/2}^{-1}g_{9/2})4\rangle + (0.07 \mp 0.16)|(f_{5/2}^{-1}g_{9/2})4\rangle$. (auth)

35298 NEUTRON RADIUS OF ^{208}Pb. Nolen, J. A. Jr.; Schiffer, J. P.; Williams, N. (Argonne National Lab., Ill.). Phys. Lett., 27B, 1-2(May 27, 1968).

A simple method is presented for calculating the radius of the neutron distribution of a nucleus from the energy of the isobaric analog state and the charge radius. The rms radius of the neutron distribution of ^{208}Pb is calculated using the experimentally determined rms charge radius of 5.51 fm and the Coulomb displacement energy of 18.98 MeV. An rms neutron radius larger than the proton radius by 0.07 ± 0.03 fm is obtained. (auth)

35299 ANALOGUE STATES AND THE NUCLEAR STRUCTURE OF ^{181}Hf. Allan, D. L.; Britt, H. C.; Rickey, F. A. Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Lett., 27B: 11-12(May 27, 1968).

Analogue resonances were observed in the elastic and inelastic proton scattering on the deformed nucleus ^{180}Hf. Evidence is presented for strong vibrational admixtures in certain ^{181}Hf states. (auth)

35300 AVERAGE CROSS SECTION OF THE ^{103}Rh(n,p)^{103}Ru REACTION IN A FISSION NEUTRON SPECTRUM. Francois, J. P.; De Soete, D.; Hoste, J. (Ghent Univ.). Radiochim. Acta, 8: 192-6(Dec. 1967).

For the determination of the average cross section of the ^{103}Rh(n,p)^{103}Ru reaction, a quantitative separation of ruthenium from rhodium was performed by distillation of ruthenium from a $NaBrO_3-H_2SO_4$ medium. In the conditions described, ca. 0.003% of iridium and 0.008% of antimony were found to distill. The average cross section was calculated from the apparent concentration of ruthenium induced in rhodium sponge which was made ruthenium-free by distillation. At a thermal to fast neutron flux ratio of 7.2, the apparent ruthenium concentration was 22 ppM. For the average fission cross section of the ^{103}Rh(n,p)^{103}Ru reaction, a value of 0.093 ± 0.001 mb was found. This value is about a factor 5 lower than the one predicted by Roy and Hawton. (auth)

35301 MEASUREMENT OF CROSS SECTIONS OF (n,p) AND (n,α) REACTIONS ON TUNGSTEN FOR REACTOR NEUTRONS. Rivier, J.; Blachot, J.; Hocquenghem, J. C. (Centre d'Etudes Nucleaires, Grenoble, France). Radiochim. Acta. 8: 196-200 (Dec. 1967). (In French).

The cross sections of the reactions ^{182}W(n,p)^{182}Ta, ^{183}W(n,p)^{183}Ta, and ^{184}W(n,α)^{181}Hf, induced by reactor neutrons, were measured. Targets of W metal and of sodium tungstate were irradiated in a fast neutron flux of the order of 10^{14} n/cm$^2\cdot$sec. The ^{181}Hf, ^{183}Ta, and ^{182}Ta activities were measured, after chemical separation, using an Na I(Tl) crystal or a Ge(Li) detector. The values obtained for the cross sections of the three reactions were 3.8 ± 0.6, 2.8 ± 0.5, and 0.19 ± 0.4 μb, respectively; these values were compared with the values proposed by Hughes and Roy-Hawton. (D.C.W.)

35302 DECAY OF ^{139}Pm, ^{140}Pm, AND ^{141}Pm. Bleyl, H.-J.; Muenzel, H.; Pfennig, G. (Kernforschungszentrums, Karlsruhe, Ger.). Radiochim. Acta, 8: 200-4(Dec. 1967). (In German).

The decay of the Pm isotopes 139, 140, and 141, which were produced by deuteron irradiation of ^{142}Nd, was investigated. The numerical analyses of the decay curve of the chemically separated Pm sample yielded the following half-lives: ^{139}Pm, approximately 6 min; ^{140m}Pm, 5.80 ± 0.05 min; and ^{141}Pm, 20.90 ± 0.05 min. Energy and relative intensity of the γ radiation were also studied. A decay scheme for ^{140m}Pm is proposed. (auth)

35303 HIGH-ENERGY γ RADIATION ACCOMPANYING THE DECAY OF ^{227}Th. Walen, Robert; Leang, Chin-fan (Centre de Spectrometrie nucleaire et de Spectrometrie de masse, Orsay, France). Compt. Rend., Ser. A and B, 266: 734-7(Mar. 11, 1968). (In French).

A γ spectrometric study was made of the fraction of the level scheme of ^{223}Ra between 440 and 1025 keV. A level scheme incorporating the results obtained is presented. (J.S.R.)

35304 EVIDENCE OF LOW-INTENSITY γ RADIATIONS IN THE DECAY ^{115m}Cd → ^{115}In. Moret, Roger (Institut des Sciences nucleaires, Grenoble, France). Comp. Rend., Ser. A and B, 266: 738-41(Mar. 11, 1968). (In French).

The study of the γ spectra in coincidence with the radiations at 935, 1133, and 1290 keV made it possible to detect the existence of transitions of 198, 317, and 130 keV. The intensity of these transitions was determined. The results made it possible to make more precise the decay scheme, notably the spin and parity of some levels. (J.S.R.)

35305 IDENTIFICATION OF PARTICLES OF ABNORMALLY LONG RANGE EMITTED FROM ^{210}Po SOURCES BY MEASUREMENT OF MULTIPLE SCATTERING IN NUCLEAR EMULSIONS. Baudinet-Robinet; Y.; Delbrouck-Habaru, J. M. Bull. Soc. Roy. Sci. Liege, 36: 659-63(1967). (In French).

Multiple scattering in nuclear emulsion was measured on tracks of long-range particles emitted by ^{210}Po sources using a previously described method. The results are compared with those obtained for proton tracks registered in the same experimental conditions. The long-range particles are identified with protons. (auth)

35306 RADIATION TRANSITIONS IN ODD IODINE ISOTOPES. Begzhanov, R. B.; Teshkabaev, K. T.; Sharipov, Sh. Dokl. Akad. Nauk Uzb. SSR, No. 4, 24-5(1967). (In Russian).

The lifetimes of the first four excited states of ^{127}I, ^{129}I, and ^{131}I were measured; and the probabilities of M1 and E2 transitions of the type $g_{7/2} \rightleftharpoons d_{5/2}$ in odd iodine isotopes were calculated using models with slight non-axiality, without separating single-particle and collective excitations. The results obtained were correlated with published data. For the isotope ^{127}I, the half-life of the first excited state at 58.5 keV was determined to be 1.79 ± 0.08 × 10^{-9} sec using the β-γ coincidence method. The half-lives of the 27- and 150-keV states in ^{129}I and ^{131}I, respectively, were measured to be 16.6 ± 0.2 × 10^{-9} and 0.94 ± 0.03 × 10^{-9} sec. Data on the probabilities of M1 and E2 transitions are presented. (R.V.J.)

35307 DECAY OF ^{95}Ru. Pinston, J. A.; Monnand, E.; Moussa, A. (CEN, Grenoble, France). J. Phys. (Paris), 29: 257-62 (Apr. 1968). (In French).

The γ-ray spectra of the decay of ^{95}Ru were studied with NaI(Tl) and Ge(Li) detectors, and the β-ray spectra were studied with an anthracene detector. Two beta groups of maximum energy 1200 and 910 keV feed the levels at 336 and 627 keV, respectively. The decay scheme of ^{95}Ru was investigated using γ-γ and β-γ coincidence experiments. (auth)

35308 USE OF BLOCKING IN CRYSTALS TO STUDY THE LIFETIME FOR FISSION OF ^{238}U BY 12-MeV PROTONS. Brown, F.; Marsden, D. A.; Werner, R. D. (Chalk River Nuclear Labs., Ont.). Phys. Rev. Lett., 20: 1449-51(June 17, 1968).

Plastic detectors were used to observe angular distributions of fission fragments emerging from a UO_2 single crystal. In fission induced by thermal neutrons and by 12-MeV protons, characteristic blocking patterns were observed, showing strong attenuations along major crystal axes. This shows that fission occurred while the nuclei were within 0.1 Å of a lattice site and indicates that the total lifetime in 12-MeV proton fission is less than 2 × 10^{-17} sec. (auth)

35309 BETA–GAMMA DIRECTIONAL CORRELATION MEASUREMENT IN ^{170}Tm AND ^{186}Re. Rao, W. V. S.; Sastry, D. L.; Jnanananda, Swami (Andhra Univ., Waltair, India). Curr. Sci. (India), 37: 311-12(June 5, 1968).

Beta-gamma cascades in the decay of ^{186}Re and ^{170}Tm were investigated. Angular correlation functions from integral correlation experiments established the first-forbidden nature of the respective beta transitions. Differential correlation measurements were made for each beta-gamma cascade at two angles (90 and 180°); and the beta-gamma anisotropy at each beta energy was estimated. The observed anisotropy in both cases was large. Differential correlation coefficients were derived from the observed anisotropies. (D.C.W.)

35310 THE ONE-PHONON VIBRATIONAL STATE OF ^{130}Te. Graue, A.; Felde, P. W.; Lien, J. R. (Univ. of Bergen). Phys. Norv., 2: 267-70(1967).

The angular distribution of deuterons scattered from the first excited state ($E_x = 839$ keV) of ^{130}Te was measured with the MIT multiple-gap broad-range magnetic spectrograph using a 7.5-MeV deuteron beam. A complex coupling DWBA calculation was used to analyze the angular distribution of the inelastically scattered deuterons, and a good fit was obtained assuming an $l = 2$ transition to the one-phonon 2^+ state. The quadrupole deformation parameter β_2, and the reduced transition probability $B(E2; 0^+ \rightarrow 2^+)$ were found to be 0.11 and $2.6 \times 10^3\ e^2fm^4$, respectively. (auth) (NORWAY)

35311 REPEATED EXPERIMENT TO OBSERVE THE WEAK NUCLEON–NUCLEON INTERACTION. Abov, Yu. G.; Krupchitskii, P. A.; Bulgakov, M. I.; Ermakov, O. N.; Karpikhin, I. L. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 27B: 16-18(May 27, 1968).

Measurements of the asymmetry in the angular distribution of 9.0 MeV γ quanta emitted by ^{114}Cd following the capture of polarized neutrons were repeated. The asymmetry was found to be $\alpha = -3.5 \pm 1.2 \times 10^{-4}$. (auth)

35312 CHARGE OF RECOIL ATOMS IN THE α DECAY OF ^{241}Am. De Wieclawik, Wladyslaw (Institut de Physique Nucleaire, Orsay, France). Compt. Rend., Ser. A and B, 266: 577-80 (Feb. 26, 1968). (In French).

The charge of recoil atoms was analyzed as a function of the number of internal conversions following α decay. Some distribution "types" were isolated for the case where this number is equal to 1, 2, or 3. (tr-auth)

35313 A STUDY ON THE YIELD OF (γ,p) REACTIONS WITH 20-MeV BREMSSTRAHLUNG. Oka, Yoshinaga; Kato, Toyoaki (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 41: 380-4(Feb. 1968).

The yields of the (γ,p) reactions on 13 elements up to an atomic number of 80, irradiated with 20-MeV bremsstrahlung, were obtained through the γ-ray spectrometric measurements of the resultant activities. The yield values, as measured in absolute disintegration rates at the end of irradiation per mole per roentgen, were plotted against atomic number of the target nuclides. The shape of the yield curve thus obtained is similar to that of the curve for the photoproton yield as a function of atomic number. The yield values are 10^8 order of magnitude in the lower-Z region, and drop rapidly with increasing atomic number up to a Z of 50. For barium and mercury targets, a yield value of 2.2×10^4 was obtained. Neutron-excess nuclides were found to be restrictive to the (γ,p) processes. The present results permit a study of general behavior of the (γ,p) reaction yields as well as of the applicabilities of the resultant activities to photoactivation analyses for many elements distributed throughout the periodic table. (NSA of Japan)

35314 S-WAVE NEUTRON STRENGTH FUNCTION, POTENTIAL SCATTERING RADIUS, AND THE OPTICAL MODEL. Ganguly, Chhaya; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 816-22(Nov. 1967).

The S-wave neutron strength function Γ_n^0/D and the potential scattering radius R′ were studied using the spherical optical model potential with pure surface absorption and combined volume and surface absorption. The numerical results were plotted against mass numbers over the region A = 40 to 200 and were compared with the experimental data. (auth)

35315 SUM COINCIDENCE SPECTROMETER AND THE STUDY OF WEAK CASCADING GAMMA RAYS. Mangal, P. C.; Sud, S. P.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 5: 596-98(Dec. 1967).

A sum-coincidence spectrometer of the type developed by A. M. Hoogenboom [Nucl. Instrum. Meth., 357(1958)] was set up for the determination of relative intensities of weak gamma rays involved in the de-excitation of complex nuclei. A fast coincidence circuit is incorporated to reduce the random coincidences. The performance of the set-up was checked with ^{60}Co and ^{22}Na sources. The relative intensities of 54-, 162-, and 276-keV γ rays of ^{133}Cs were found to be 2.9 ± 0.3, 2.7 ± 0.3, and 10.7 ± 1.1%, respectively, as compared to the 356-keV gamma ray. (auth)

35316 FIRST 2^+-LEVEL OF Sn AND Pb ISOTOPES IN THEORY OF FINITE FERMI SYSTEM. Kamerdzhiev, S. P. Yadern. Fiz., 7: 706-8(Mar. 1968). (In Russian).

The finite Fermi system theory was used to calculate the vibrational states of heavy spherical even–even nuclei with a filled proton shell, in order to illustrate how this theory handles collective oscillations. In deriving the field arising in the nucleus under the influence of an external field with a given frequency, it was assumed that this field does not affect the chemical potential; the density matrix was taken into account. An expression was obtained for the electric transition probability from the excited state to the ground state. The approach used presents advantages over L. S. Kisslinger and R. A. Sorensen's evaporation + quadrupole force model, because it takes into consideration the gaps in the external field and the effective charge and interaction constants are substituted by functions expressed through universal constants. The equations were solved for the Sn and ^{202}Pb and ^{204}Pb isotopes; values for E_2^+ and B(E2) from the ground to the first 2^+ level are presented in tabular form. (TTT)

35317 PRESSURE DEPENDENCE OF THE ISOMER SHIFT OF ^{119}Sn. Moeller, H. S. (Technische Hochschule, Munich). Z. Phys., 212: 107-21(1968).

Using recoilless gamma resonance absorption of the 23.8-keV transition of ^{119}Sn, the isomer shift was measured as a function of hydrostatic pressure up to 100 kbar. The tin isotope was introduced into the substances $SnMg_2$, metallic tin, Pd(12 wt % Sn), $Sn(SO_4)_2 \cdot 2H_2O$, and SnAu. Except for $SnMg_2$, all compounds exhibit a linear relation between isomer shift and pressure, which reflects a decrease of $|\psi(0)|^2$, the probability density of the electrons at the nuclear site, with increasing pressure. This decrease is interpreted by a volume-dependent screening of the 5s electrons by the 5p electrons. The nonlinear dependence of the isomer shift upon pressure in the case of $SnMg_2$ is interpreted in terms of the superposition of two counteracting effects, with band repopulation and electronic shielding effects prevailing in the low and high pressure branches, respectively. Measurements of the pressure dependence of both the electrical resistivity and the lattice structure of $SnMg_2$ lead to a picture, which resulted in a calculation of the pressure dependence of the isomer shift, which is in agreement with the experimental observations. (auth)

35318 AN EXPERIMENTAL STUDY OF THE CONFIGURATIONAL CONNECTIONS BETWEEN THE STATES OF AN ODD- AND AN EVEN-MASS NUCLEUS. Allan, D. L. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A114: 211-36(1968).

A charged-particle magnetic spectrograph was used to measure the relative yields of protons scattered inelastically at 90° by ^{118}Sn with the excitation of 35 levels of the final ^{118}Sn nucleus. From these data, 33 excitation curves were constructed which exhibit resonances corresponding to isobaric analog of 34 states of the neighboring odd nucleus ^{119}Sn. Resonance plots are presented whose patterns reveal many features of the configurational connections between the states of ^{118}Sn and ^{119}Sn. An experimental plot is given showing the dependence of the total width of the resonances on resonance energy. (auth)

35319 QUADRUPOLE–OCTUPOLE INTERACTION AND THE TWO-PHONON STATES. Raduta, A.; Sandulescu, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 765-70 (1967).

An interpretation of the 1^-, 3^-, and 5^- states of spherical nuclei as members of a 1^-, 2^-, 3^-, 4^-, 5^- quintet arising from the combination of one quadrupole phonon and one octupole phonon is outlined. Specifically, a microscopic theory of the quintet is developed by including a quadrupole–octupole interaction in the conventional Hamiltonian together with pairing, quadrupole, and octupole forces. (D.C.W.)

35320 QUADRUPOLE INTERACTION AND THE TWO QUADRUPOLE–OCTUPOLE PHONON STATES. Raduta, A.; Sandulescu, A.; Stratan, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 869-71(1967).

In a preceding paper (Rev. Roum. Phys., 12: 765(1967)), the anharmonic effects of quadrupole–octupole interaction on the two-phonon states of spherical nuclei were investigated. The anharmonic effects of quadrupole forces on the two-phonon states are now studied. (D.C.W.)

35321 CONVERSION COEFFICIENTS AND FLUORESCENCE YIELDS OBSERVED AT THE DECAY OF ^{192m}Ir AND ^{58m}Co. Wilken, Berend (Univ., Goettingen, Ger.). Z. Phys., 213: 56-69(1968). (In German).

With a proportional counter and an anthracene-crystal spectrometer, the L x-ray and the conversion-electron spectra of Ir^{192m_1} were measured. The L fluorescence yield of iridium was found to be $\omega_L = 0.30 \pm 0.04$. The partial fluorescence yields of the L_2- and L_3-subshells could be determined: $\omega_{L2} = 0.35 \pm 0.14$ and $\omega_{L3} = 0.29 \pm 0.04$. The conversion coefficients for the isomeric transition of Ir^{192m_1} were also measured: $\alpha_L = 1660 \pm 250$ and $\alpha_L + \alpha_M = 2030 \pm 230$. The spectra of the conversion electrons of the 25 keV isomeric of ^{58m}Co were measured with a methane-filled proportional counter, and the γ and x rays were measured with a NaI scintillation spectrometer. The conversion coefficients for this transition and K fluorescence yield of cobalt were found to be $\alpha_K = 2000 \pm 260$, $\alpha_{L+M} = 890 \pm 150$, $K/(L + M) = 2.25 \pm 0.15$, $\omega_K = 0.34 \pm 0.02$. (auth)

35322 MOESSBAUER EFFECT IN ^{157}Gd AND ^{155}Gd. Prange, Heinz (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 212: 415-34(1968). (In German).

Using the Moessbauer technique, electric hyperfine interactions of the first excited nonrotational states at 64 keV in ^{157}Gd and at 86.5 keV in ^{155}Gd were determined in GdF_3 and $GdCl_3 \cdot 6H_2O$. For the ratio of the quadrupole moments, the ratios $Q_{64}^{157}/Q_g^{157} = 1.78 \pm 0.04$, $Q_{86.5}^{155}/Q_g^{155} = -0.07 \pm 0.21$, and $Q_g^{155}/Q_g^{157} = 0.78 \pm 0.06$ were found. In addition, isomer shifts were observed from which a ratio $\delta\langle r^2\rangle_{64}^{157}/\delta\langle r^2\rangle_{86.5}^{155} = -2.6 \pm 0.15$ can be inferred. (auth)

35323 INVESTIGATIONS ON ENRICHED ISOTOPES WITH NATURAL ALPHA RADIATION. Kauw, Gisela (Univ., Bonn). Forschungsber. Landes Nordrhein-Westfalen, No. 1640, 27p (1966). (In German).

In the enriched isotopes ^{142}Ce, ^{152}Gd, ^{174}Hf, and ^{204}Pb, an α decay can be detected. The activity observed by Porschen on natural Pt was assigned to ^{190}Pt. The results of the studies on ^{180}W do not agree with the results on natural W. Possibly ^{180}W shows an α activity. In some other enriched isotopes, the upper limit of the half-life could be determined. These values are tabulated for ^{142}Ce, ^{143}Nd, ^{145}Nd, ^{152}Gd, ^{156}Dy, ^{174}Hf, ^{180}W, ^{183}W, ^{190}Pt, ^{192}Pt, and ^{204}Pb. With these values, the systematics of the α emitters in the mass range from 140 to 210 can be expanded. The energies of the emitted α particles were plotted with respect to the mass number. An evaluation of the graph showed that the energy dip in the region between the light rare earths and Bi shows no strong dislocation as the shell model predicts. Exceptions are ^{160}Dy, whose mass difference does not lie on the isotope line, and ^{158}Dy for which no measureable α decay could be detected. (tr-auth)

35324 ISOMERIC YIELD RATIOS OF ^{133}Xe IN FISSION OF ^{232}Th, ^{233}U, ^{235}U, AND ^{238}U WITH PROTONS OF ENERGIES 20 TO 85 MeV. Forster, J. H.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 46: 1763-72(May 15, 1968).

The ratio of ^{133}Xe isomers produced in the fission of ^{232}Th, ^{233}U, ^{235}U, and ^{238}U by protons ranging in energy from 20 to 85 MeV was measured. The Hafner, Huizenga, and Vandenbosch formalism was applied with different sets of input parameters to establish their effect on the relation between initial fragment spin and isomer ratio for three spin-pair classes of isomers. The isomer ratio was found to be independent of the spin and type of fissioning target and only weakly dependent on projectile energy. (auth) (Canada)

35325 CUMULATIVE YIELDS IN THE 14-MeV NEUTRON FISSION OF ^{238}U. Gorman, D. J.; Tomlinson, R. H. (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 46: 1663-72(May 15, 1968).

The isotopic abundances of the elements xenon, krypton, and cesium formed in the 14-MeV neutron fission of ^{238}U have been measured mass spectrometrically. The relative yields of some isotopes of krypton, strontium, zirconium, molybdenum, ruthenium, iodine, xenon, barium, cerium, and neodymium were measured using a Ge(Li) detector. The ratios were normalized through isobaric nuclides, and absolute yields were obtained by normalizing the sum of the heavy-mass yields to 100%. The results indicate that the fine structure persists at this excitation energy. In particular, the peak at A = 134 which is so characteristic of thermal fission is still prominent in 14-MeV fission. (auth) (Canada)

35326 (^{3}He,α) REACTIONS ON ACTINIDE ELEMENTS. Elze, Th. W.; Von Egidy, T.; Huizenga, J. R. (Univ. of Rochester, N. Y.). Phys. Lett., 27B; 78-80(June 10, 1968).

The [743↑] Nilsson configuration in ^{237}U is identified by a study of the reaction ^{238}U(^{3}He,α)^{237}U. An intense l = 7 transition to the $^{15}/_2{}^-$ level of this band is observed. (auth)

35327 DECAY OF ^{119}Te ISOMERS AND STRUCTURE OF ^{119}Sb. Kantele, J; Hattula, J.; Hattula, T.; Kalm, H.; Marttila, O. J. (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 259, 29p(1967).

The disintegrations of 16-hr ^{119g}Te and 4.7-d ^{119m}Te were investigated with Ge(Li) and NaI(Tl) detectors and detector combinations. On the basis of a quantitative analysis of gamma-gamma coincidence spectra, all principal features of the decay schemes were established, in agreement with recent proposals in the literature. From EC/β^+ branching ratio measurements, an upper limit of 2.56 MeV is determined for the electron-capture disintegration energy of ^{119m}Te. These measurements also suggest a disintegration energy of 2.24 MeV for the ground state of ^{119}Te. With the aid of a fast coincidence spectrometer, upper limits of 250 and 200 ps are obtained for the half-lives of the 270- and 1366-keV levels in ^{119}Sb, respectively. The present half-life and the internal conversion data reported in the literature suggest that the 1366-keV gamma transition which connects the latter level to the ground state is of E3 character and has a speed of more than 10 spu. This implies that the 1366-keV level is an $^{11}/_2{}^-$ state with strong collective octupole admixture. The reaction ^{118}Sn(^{3}He,d)^{119}Sb was studied with 19-MeV incident particles at an observation angle of 40°, the deuteron spectrum being recorded by a magnetic spectrograph. Several new levels observed in this reaction, together with levels populated in the decay of ^{119m,g}Te, are discussed in light of relevant nuclear models. The present data are consistent with a strong proton-core interaction, since evidence is found for the odd particle being coupled to the quadrupole and octupole vibrations of the even-even core. (auth)

35328 ON THE DECAY OF 30s ^{106g}Rh. Hattula, J.; Liukkonen, E. (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 274, 14p(Mar. 1968).

The decay of ^{106g}Rh was studied by means of Ge(Li) detectors, an anti-Compton arrangement and a new gamma-gamma directional correlation measurement method based upon the integral-bias summing coincidence spectrometer. A total of 45 gamma transitions was found, including several which were previously unknown. Some Ge(Li) – NaI(Tl) coincidence measurements were made. The E2/M1 mixing ratio of the 616 keV $2^+ - 2^+$ transition was measured directly. A level scheme was constructed for the decay of ^{106g}Rh, consisting of 19 levels, of which those at 1706.3, 2242.5, 2501, and 2902 keV are new. The levels of ^{106}Pd are compared with those predicted by the quadrupole vibrational model, and with levels from inelastic proton and deuteron scattering. (auth)

35329 NEW GAMMA TRANSITIONS IN ^{165}Dy BETA DECAY. Rusakov, T.; Tomov, T.; Lefterov, D. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1259-61(1967). (In Russian).

^{165}Dy sources were prepared by the irradiation of Dy_2O_3 in the IRT-1000 reactor at a flux of 10^{12}n/sec cm^2 for 20 min. The data obtained from α-ray spectrum measurements made with a planar 2.5-mm-thick Ge(Li) detector, were assigned to the two isomers of ^{165}Dy with half-lives of 1.25 min and 2.36 hr. The information concerning the first isomer was found to agree with earlier data, but new transitions were observed for the 2.36-hr isomer. The new transition energies were 265, 544, 575, 660, 992, and 1028 keV. The calibration of the instruments used was not sufficiently precise to place the new and earlier transitions into a consistent decay scheme. (TTT)

35330 PERMISSIBLE RANGE FOR PARAMETER USED IN INTERMEDIATE-RESONANCE TREATMENT. Ishiguro, Yukio (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 255-7(May 1968).

The possible range of applicability of the intermediate resonance parameter is studied. A homogeneous system of zero temperature is treated for simplicity, and the narrow resonance approximation is assumed for moderator scattering. (D.C.W.)

35331 EXISTENCE OF A 1-HR ^{129}Sn ISOMER NOT CONFIRMED. Pappas, A. C.; Strom, P. O.; Westgaard, L. (Univ. of Oslo). J. Inorg. Nucl. Chem., 30: 890-1(May 1968).

Two isomers of ^{129}Sn were reported by Hagebo et al. (J. Inorg. Nucl. Chem., 24: 117(1962)), with half-lives of 8.0 ± 0.6 min and 1.0 ± 0.1 hr, and with the longer-lived species in much lower fission abundance. Other workers, however, did not observe the longer-lived isomer. The present communication describes studies in an endeavor to clear up this ambiguity. No longer-lived ^{129}Sn activity was found, and it was concluded that the 1-hr ^{129}Sn reported was most likely caused by an unknown irreproducible behavior of Sn and Sb due to instability of the ether-thiocyanate system used for separation of these elements in the milking procedure. (UK)

35332 RATIO OF ^{85}Kr ISOMERS PRODUCED IN MEDIUM-ENERGY FISSION. McHugh, J. A.; Michel, M. C. (Univ. of California, Berkeley). J. Inorg. Nucl. Chem., 30: 673-6(May 1968).

The independent isomer yields for ^{85m}Kr and ^{85}Kr in the α-induced fission of ^{232}Th and ^{235}U were obtained from mass-spectrometric measurements of the relative fission yields of the krypton isotopes. It was found that a high fraction (≥0.8) of the independently formed ^{85}Kr populates the high-spin isomer for the range of compound-nucleus excitations investigated (23 to 57 MeV). (auth) (UK)

35333 MEASURING THE RELATIVE INTENSITY OF FISSION REACTIONS. Bondarenko, V. V.; Bushuev, A. V.; Voropaev, A. I.; Zinov'ev, V. P.; Ukraintsev, F. I.; Yurova, L. N. At. Energ. (USSR), 24: 82-4(Jan. 1968). (In Russian).

In obtaining information on the space-energy distribution of neutrons in a reactor, the distributions of fission intensities of different isotopes are measured at various points with fission chambers or by an activation method. A series of measurements were made on a fast neutron assembly containing rods filled with enriched uranium. Small fission chambers (8 mm in diameter and 40 mm in height), and natural and 90% uranium foils were used in the measurements. The fission product activity in the foils was measurements. The fission product activity in the foils was measured on a NaI(Tl) counter. An analysis of the experimental results showed that inhomogeneities due to the heterogeneity of the lattice were observed in the space-energy distribution of neutrons. The neutron spectra in the channels and in the spaces between the channels differed considerably. The heterogeneity of the system had an effect on the ^{238}U fission reaction, but not on the ^{235}U fission reaction. Both the fission chamber and foil activation methods were free of systematic errors as shown by experiments in a homogeneous region. (TTT)

35334 AN INVESTIGATION OF THE GAMMA RAYS ASSOCIATED WITH THE DECAY OF ^{110m}Ag, ^{124}Sb, ^{182}Ta, AND ^{206}Bi. Sullivan, Robert Patrick. New Orleans, La., Tulane Univ. 91p.
Thesis.

The gamma rays associated with the decay of ^{110m}Ag, ^{124}Sb, ^{182}Ta, and ^{206}Bi were investigated using a Compton spectrometer and a single Ge(Li) detector spectrometer. Gamma-ray energies and relative intensity assignments are made. In the decay of ^{110m}Ag, a new gamma transition of 1004 keV between the 2479 (6^+) and 1476 (2^+) levels was observed. In the decay of ^{124}Sb, new gamma rays of 794.3, 860.4, and 1103.5 keV were observed and were fitted to the decay scheme by proposing a new level in ^{124}Te at 1103.5 keV. In the decay of ^{182}Ta, new gamma rays of 1331, 1365, and 1594 keV were observed and were fitted to the decay scheme by proposing a new level in ^{182}W at 1694.5 keV. In the decay of ^{206}Bi, the 1846-, 1881-, and 1902-keV gamma rays recently reported were confirmed. (Disser. Abstr.)

35335 MEASUREMENT OF BETA SPECTRA BY COMBINED MAGNETIC MOMENTUM SELECTION AND SEMICONDUCTOR ENERGY SELECTION. Hsue, Sin-tao. Bloomington, Ind., Indiana Univ., 1967. 69p.
Thesis.

In measuring beta spectra with a magnetic spectrometer, there is always some distortion due to instrumental scattering. The presence of scattering increases the uncertainty in determining the end point of a beta spectrum. The distortion is especially large in measuring the weak beta transitions in the presence of intense ones. By using energy-sensitive detectors at the focus of a magnetic spectrometer, it is possible to demand energy selection as well as momentum selection of the electrons. The additional energy selection can be used to eliminate scattering electrons in the spectrometer. The details of this method have been worked out for solid-state detectors with a 180° focusing, shaped magnetic field spectrometer. This method has been applied to determine the endpoint of the RaE beta spectrum. The difficulty in determining the end point of the RaE spectrum more precisely arises from the ambiguities in the scattering correction. This method enables us to determine the end-point energy without such correction, and, therefore, should be more satisfactory. The end point of the RaE beta spectrum was determined to be 1.1615 ± 0.0015 MeV. This method has also been applied to measure the weak outer group beta spectrum of ^{137}Cs. Because of the presence of the ~94% intense beta transition and the intense conversion lines, scattering distortion to the weak outer group beta spectrum is rather substantial. With this method, we were able to measure free from scattering distortion the outer group beta spectrum of ^{137}Cs. It was found that scattering distortion in this case could be as large as 10%. The experimental shape of the outer group was best fitted with a twice-forbidden, non-unique shape of the form $q^2 + \lambda^2 p^2$, $\lambda^2 = 0.004 \pm 0.002$ or with $L_0 q^2 + 9\lambda^2 L_1$, $\lambda^2 = 0.005 \pm 0.002$. The result is in excellent agreement with measurements performed by employing another method to reduce scattering. This method has also been applied to measure the weak outer group beta spectrum of ^{47}Ca. Due the presence of the ~84% intense inner group, scattering distortion to the ~15% intense outer group is again large. It was found that scattering distortion in this case could be as large as 6%. The shape factor of the outer group can be fitted with an allowed shape, although the possibility of a nonstatistical shape cannot be ruled out. These experiments indicate that the use of the energy selection by the detector as well as momentum selection by the magnetic spectrometer to measure beta spectra is a rather effective method in discriminating against scattering particles, and can be easily applied to magnetic spectrometers in general. (Disser. Abstr.)

35336 PRECISE MEASUREMENT OF THE INTERNAL CONVERSION COEFFICIENT OF THE 45-keV TRANSITION IN ^{236}U. Duke, Charles Lewis. Ames, Iowa, Iowa State Univ., 1967. 84p.
Thesis.

The total internal conversion coefficient of the 45-keV $2^+ \rightarrow 0^+$ transition in ^{236}U was measured by analysis of photon spectra observed using a well-type NaI(Tl) detector, in coincidence with the 5.115-MeV alpha group from the decay of ^{240}Pu. The alpha spectra from the gating detector were analyzed on a computer using a least squares curve-fitting program to correct for the contribution to the gating from the 5.159 MeV ground-state alpha group. The NaI(Tl) photon efficiency for the transition was calculated using a computer program that included angular correlation effects. The result for the total internal conversion coefficient of the 45-keV E2 transition in ^{236}U was 607 ± 29. This value is in agreement with the theoretical calculations of Rose and Sliv and Band. A pile-up rejection circuit developed for this investigation is described. (Disser. Abstr.)

35337 STRENGTH FUNCTIONS AND THE OPTICAL MODEL. Divadeenam, Mundrathi. Durham, N. C., Duke Univ., 1967. 156p.
Thesis.

Neutron cross sections measurements on the separated isotopes ^{92,94,95,96,98,100}Mo and remeasurements on natural Ru, Rh, La, Hf, Ta, W, Ir, Os, Tl Bi, Th, and U were made with improved techniques to minimize inscattering background when only small size samples are available for transmission measurements. Cross sections when averaged over hundreds of keV reveal both s- and p-wave giant resonance structure when plotted against A. Spherical non local and local potential model and collective potential model calculations are compared with averaged cross sections. Spherical non local and collective potential model predictions agree excellently with the experiment. The low resolution cross section method (Duke Method) was employed to estimate s-, p-, and d-wave strength functions and R′ from the measured cross sections referred to above, older Duke measurements, and published Wisconsin measurements. The estimated results are compared with both spherical and collective potential model calculations. p-wave strength functions are in good agreement with the collective model predictions, whereas an overall agreement is found with the collective model calculations in the case of s-wave strength functions, but some mass-regional discrepancies still persist. d-wave strength functions indicate two broad giant resonances at A = 60 and 160; the one at higher mass number seems to be split into two peaks which can not be explained by spherical potential model calculations. Cross sections averaged over 25 keV reveal intermediate structure in the case of Mo isotopes. The structure is damped out in the case of one odd isotope. (Disser Abstr.)

35338 TOTAL CROSS SECTIONS FOR 14-MeV NEUTRONS. Haugsnes, Jack. Evanston, Ill., Northwestern Univ., 1967. 97p.
Thesis.

Total cross sections were measured in good geometry for 14.10 ± 0.18-MeV neutrons from the T(d,n)^{4}He reaction. The neutrons were collimated by counting fast neutron-alpha coincidences. This provided an experimental correction for normal counter background, room scattered neutrons, extraneous background, and neutrons and photons from inelastic events in the sample. An experimental inscattering correction was made by determining the transmission at the center and at the edge of the cone of coincidence neutrons. The results of the measurements are 2.61 ± 0.02 b for Fe, 4.29 ± 0.02 b for Pd, 4.42 ± 0.03 b for Cd, 5.06 ± 0.03 b for Nd, 5.01 ± 0.04 b for Sm, 5.32 ± 0.05 b for Er, 5.37 ± 0.02 b for Hf, 5.02 ± 0.03 b for Ta, and 5.40 ± 0.04 b for Pb. These results and those of other measurements at 14.10 MeV are compared to values which have been calculated for four different optical models. (Disser. Abstr.)

35339 A STUDY OF SLOW NEUTRON SCATTERING BY ISOTOPES OF ERBIUM. Kolotyi, V. V.; Vertebnyi, V. P.; Gnidak, N. L.; Pisanko, T. I. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 599-604(Apr. 1968). (In Russian).

The cross sections of slow neutron scattering by ^{162,164,166,167,168,170}Er were measured. The measurements were performed by using 4π geometry and the time-of-flight method. The data obtained were analyzed and were compared with the theory. (auth)

35340 DETERMINATION OF TOTAL SCATTERING CROSS SECTIONS OF THERMAL AND EPITHERMAL NEUTRONS BY SOME RARE-EARTH ELEMENTS. Vertebnyi, V. P.; Gnidak, N. L.; Kolotyi, V. V.; Pavlenko, E. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 605-8(Apr. 1968). (In Russian).

The cross sections of neutron scattering by nuclei of Ho, Lu, and Dy were measured over the energy range of 0.02 to 1.0 eV The measurements were performed by using 4π geometry and the time-of-flight method. (auth)

35341 ON THE K-CONVERSION COEFFICIENT OF THE 393-keV TRANSITION IN ^{113}In. Tajibnapis, W. D.; Ramaswamy, M. K.

(Fordham Univ., Bronx, N. Y.). Nuovo Cim., 55B: 591-2(June 11, 1968).

The photon spectrum from ^{113m}In, which was obtained by eluting a column of ^{113}Sn, was measured using NaI detectors for both the In K x ray and the 393-keV γ ray. The γ spectrum was also measured using a Ge(Li) detector. A value of 0.454 ± 0.012 was obtained for the K-conversion coefficient; this value is consistent with an M4 assignment for the transition. (D.C.W.)

35342 LEVEL SCHEME OF ^{123}Sb. Jeronymo, J. M. F. (PUC, Rio de Janeiro); Leal da Costa, N.; de Pinho, A. G.; Goldman, I. D.; Guillaumon, J. A. Nuovo Cim., 55B: 492-503(June 11, 1968).

Two new transitions in ^{123}Sb from the beta decay of the $\frac{3}{2}^+$ ground state of ^{123}Sn were found: one with 381.3 0.7 keV corresponding to $2.7 \pm 0.3 \times 10^{-2}$% of the disintegrations and one with 542.2 ± 0.9 keV corresponding to $1.6 \pm 0.3 \times 10^{-2}$% of the disintegrations. The search for a 170-keV transition depopulating the 712-keV level gives an upper limit of 2×10^{-2}% of the disintegrations. To describe properties of the level scheme of ^{123}Sb, calculations were made on the basis of a model which assumes the coupling of the unpaired proton with an even-even core via a phenomenological core-to-particle interaction. The theoretical results concerning energies, spectroscopic factors, and electromagnetic properties are compared with previously published and presently given experimental data with fairly good agreement. (auth)

35343 A STUDY OF THE ENERGY DEPENDENCE OF THE ^{232}Th CAPTURE CROSS SECTION IN THE ENERGY REGION 0.1 TO 3.4 eV. Lundgren, Goeran (Univ. of Uppsala). Nukleonik, 11: 61-7(1968). (AE-304).

Using the fast chopper at the Stockholm reactor R 1 a comparison between the (n,γ) cross sections for thorium and copper was made in the energy interval 0.1 to 3.4 eV. The (n,γ) cross section for copper follows the 1/v law sufficiently well in this energy interval to be used as a 1/v standard. The deviation at 3.4 eV does not exceed 5%. The capture cross section, σ_γ, for thorium decreases more rapidly than 1/v and the deviation is found to be close to 60% at 3.4 eV. If one assumes that the deviation is caused essentially by a single negative resonance this should be located at 5.1 ± 0.5 eV. Furthermore, if a value of 24 MeV for Γ_γ, the radiation width for the negative resonance, is used one finds that Γ_n^0, the reduced neutron width for the same resonance, amounts to 1.8 ± 0.4 MeV. Using these parameters together with the resonance parameters for the positive resonances a value of the total microscopic scattering cross section at 0.025 eV has been calculated as 12.2 ± 0.4 b. A value of the contributions above 0.5 eV to the resonance integral from the "tail" of the negative resonance and the 1/v parts of the positive resonances has also been calculated giving the result 1.6 b. Finally, the g-factor (Westcott's nomenclature) for a Maxwellian spectrum at 20°C becomes 0.995. (auth)

35344 RE-EVALUATION OF ^{235}U, ^{238}U, AND ^{239}Pu CROSS-SECTIONS BASED ON MICROSCOPIC AND INTEGRAL DATA. Rakavy, G.; Reiss, Y.; Samoucha, D.; Yeivin, Y. (Hebrew Univ., Jerusalem). pp 255-66 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A generalized least-squares method to improve microscopic cross-section evaluations by means of integral data was applied to re-evaluate the cross sections of ^{235}U, ^{238}U, and ^{239}Pu, using critical-mass data of 24 simple metallic systems composed of these isotopes. It was found that, after some minor modifications of the original cross section set, most of the experimental integral data could be reproduced. The cross-section modifications, as a rule, were of the order of a few per cent and well within the uncertainties in the cross-sections. The exception to the rule was the ^{239}Pu fission cross section in the energy range up to about 150 keV, which had to be decreased by 15 to 20%. This result independently confirms the recent measurements of White et al. (auth)

35345 NEW METHOD OF MEASURING ALPHA(E) FOR ^{239}Pu. Schomberg, M. G.; Sowerby, M. G.; Evans, F. W. (Atomic Energy Research Establishment, Harwell, Eng.). pp 289-301 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A special liquid scintillator detector has been developed for the purpose of measuring alpha(E) for ^{239}Pu in the energy range 10 eV to 30 keV using the Harwell Linear Accelerator time-of-flight spectrometer. Alpha(E) is the ratio of capture to fission cross sections as a function of incident neutron energy. The detector has two outputs, one responding to gamma-ray interactions and the other to fast neutrons. The efficiency of the detector for gamma rays is arranged to be proportional to the gamma-ray energy. This property is achieved by utilizing an improved Moxon-Rae design and ensures that the efficiency of the detector for radiative capture events is constant irrespective of the nature of the gamma-ray cascade. The fast neutrons are also detected in the liquid scintillator and pulse shape discrimination is used to reject events produced by gamma rays. As a gamma-ray detector the device is sensitive to both radiative capture events and to the prompt gamma rays produced in fission. However, a correction for this latter component is made using the information from the fast neutron output which is essentially only sensitive to fission events. For each of the time-of-flight timing channels the ratio of the corrected counts from the gamma detector to the number of fission events detected is equal to K × alpha(E), where K is a constant determined by normalization. The technique of measuring both capture and fission simultaneously ensures that incident neutron energy spectrum charges and resolution effects are unimportant and also reduces the multiple scattering corrections. The detector system is described and some of the data obtained are shown. (auth)

35346 NEUTRON CAPTURE AND FISSION CROSS-SECTION DATA IN THE keV ENERGY RANGE. SOME NEW MEASUREMENTS AND RENORMALIZATIONS. Beckurts, K. H.; Kompe, D.; Menlove, H. O.; Poentiz, W. P. (Kernforschungszentrum, Karlsruhe, Ger.). pp 67-76 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Some new measurements of capture cross sections were performed using the 3-MeV Karlsruhe pulsed Van de Graaff accelerator. A major effort was undertaken to measure the absolute gold capture cross section as a function of energy between 25 and 500 keV in order to establish a reliable standard for capture and fission cross-section renormalizations. To do this, a well-collimated pulsed beam of monoenergetic neutrons produced in a thin lithium target at 80° to the proton beam direction was used to irradiate a 0.1-cm thick sample in the center of a large liquid scintillator which detects the prompt capture γ rays. The relative neutron flux was measured with a "grey neutron detector" which is relatively insensitive to neutron energy variations in the energy range of these measurements. The gold cross-section shape was normalized at 30 keV to an absolute value fitted from various recent experiments. By a similar technique, the capture cross section of ^{238}U in the energy range 25 to 500 keV was determined. Furthermore, cross sections of several medium- and heavy-weight nuclei which may be of some interest to reactor design (Nb, Mo, Cs, Hf, Ta, W, Re) were determined by a time-of-flight method, using the gold value as a standard. The data are presented, and some implications of the new data on reactor calculations are reviewed. (auth)

35347 BASIC NUCLEAR DATA FOR THE HIGHER PLUTONIUM ISOTOPES. Yiftah, S.; Schmidt, J. J.; Caner, M.; Segev, M. (Soreq Nuclear Research Centre, Yavne, Israel). pp 123-49 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Fast reactor fuel may have an appreciable content of high Pu isotopes, the amount varying according to the source. Therefore, in calculations of static and dynamic reactor characteristics, reliable basic nuclear data are needed not only for ^{239}Pu but for the higher isotopes as well. Reactor computations depend on cross sections as functions of energy, dilution and temperature. Basic nuclear data for a fuel isotope consists therefore of average cross sections and resonance parameters. Experiment alone does not furnish such data in a final complete form. In fact, the experimental information needs interpretation, weighting, evaluation and often also interpolation on theoretical grounds. Within the framework of contracted research with the Association EURATOM-Karlsruhe on fast reactors, an evaluation was made of basic nuclear data for the high Pu isotopes. Some pertinent parts and aspects of the evaluation are summarized. Resonance parameters and cross sections are presented for ^{240}Pu, ^{241}Pu, and ^{242}Pu in the form of experimental and recommended data. Complete sets of parameters include the first 43, 61, and 20 resonances of these isotopes, respectively. Average parameters are derived from these sets, to be used at higher energies where either the parametrization is incomplete or the resonances unresolved. Although the samples are, as a rule, too poor for a direct derivation of statistical distributions, there is enough general knowledge on the subject today to fix these distributions within narrow limits. (auth)

35348 SELF-SHIELDING FACTORS FOR URANIUM AND PLUTONIUM. Segev, M.; Yiftah, S.; Caner, M. (Soreq Nuclear Research Centre, Yavne, Israel). pp 113-22 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Self-shielding factors for ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu are presented for several energies and temperatures as functions of dilution. They were calculated by the "ladder" method, a variant which was especially developed to gain high accuracy in short computer time. A brief description of the method is given. The temperature-dilution dependence of the cross sections displayed by these shielding factors is free from the assumptions of either small fluctuations or isolated resonances. (auth)

35349 PREDICTION OF NEUTRON CROSS-SECTIONS IN THE ENERGY RANGE 1.0 TO 10.0 MeV. Garg, S. B.; Rastogi, B. P. (Bhabha Atomic Research Centre, Bombay). pp 95-111 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Neutron total, shape elastic, and reaction cross sections in the energy range 1 to 10 MeV were calculated for Nb, Pb, ^{239}Pu, and ^{235}U, which are extensively used in fast nuclear reactors as structural, shielding, and fissile materials, by means of the local spherical optical model. It is concluded that highly deformed nuclides like ^{235}U and ^{239}Pu can be represented fairly well with a suitable local spherical optical potential and the cumbersome approach of the nonlocal deformed optical model can be avoided in the first approximation. The real part (U) of the neutron-nucleus potential is represented by the Woods-Saxon form and the imaginary part (W) by the Gaussian form. The whole range of 1 to 10 MeV was split up into slabs over which the average values of U, W, a (surface diffuseness), b (Gaussian width) and γ_0 were determined which give good fits to the measured total cross sections. The maximum deviation from the measured value is found to be 15% but in general the agreement is reasonably good. For Nb no measurements are available beyond 3 MeV and so these calculations serve to fill in the gap. For the doubly magic nuclide lead the imaginary part of the potential is small as expected. The reaction cross section was split up into compound elastic and inelastic parts by using the Hauser-Feshbach statistical theory. (auth)

35350 GAMMA SPECTRA OF Ba ISOTOPES PRODUCED BY (n,γ) REACTIONS. Batist, L. Kh.; Vrzal, Ya.; Dzhelepov, B. S.; Liptak, Ya.; Podkopaev, Yu. N.; Urbanets, Ya. (Leningrad State Univ. Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1672-5(Oct. 1967). (In Russian).

Gamma spectra of ^{131}Ba ($T_{1/2}$ = 11 days), ^{133}Ba (7.5 years), ^{133*}Ba (38.9 hr), and ^{135}Ba and ^{135*}Ba (28.7 hr) were studied at energies exceeding 200 keV. A semiconductor γ spectrometer was used for studying γ spectra of ^{131}Ba and ^{139}Ba at energies exceeding 100 keV, and a γ hodoscope was used for γ spectra of ^{139}Ba in the 1300- to 2400-keV range. The single spectrum of ^{139}Ba taken with Ge(Li) detector with 5 mm sensitivity layer is constructed. Data on the energy and relative intensities of γ rays for ^{131}Ba, ^{133}Ba, and ^{139}Ba are tabulated and analyzed. (R.V.J.)

35351 STUDIES OF ^{197}Hg AND ^{197*}Hg γ EMISSIONS. Burmistrov, V. R.; Andreev, Yu. A.; Vongai, A. D.; Karetskaya, S. P.; Novgorodov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1676-8 (Oct. 1967). (In Russian).

Gamma spectra for ^{197}Hg and ^{197*}Hg in the energy range from 50 to 1000 keV were studied using a semiconductor spectrometer with a 2-cm Ge(Li) crystal and an AI-256 pulse amplitude analyzer. The spectrometer calibration was carried out using ^{114}In, ^{203}Hg, ^{137}Cs, ^{22}Na, ^{60}Co, and ^{124}Sb sources. Studies were made in a 50- to 1000-keV energy range. The γ transitions were determined by the half-lives. In standard measurements, the decay was observed for 5 to 10 half-life periods for each isomer. A decay scheme for ^{197}Hg is proposed on the basis of the experimental data. (R.V.J.)

35352 DECAY OF ^{106*}Ag. Vrzal, Ya.; Grigor'ev, E. P.; Zolotavin, A. V.; Katykhin, G. S.; Liptak, Ya.; Urbanets, Ya. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1656-60(Oct. 1967). (In Russian).

Studies were made of γ spectra appearing during the decay of ^{106}Ag ($T_{1/2}$ = 8.4 days), which has spin and parity 6^+. The γ-ray source for ^{106}Ag was obtained by irradiation of Cd target by 660-MeV protons. The measurements were carried out with a Ge(Li) detector. Tabulated theoretical and experimental data on energy-level transitions in ^{106}Pd, K-conversion line and γ-ray intensities, and conversion coefficients were compared and analyzed. The results obtained were used to construct the decay scheme of ^{106}Ag. (R.V.J.)

35353 ON THE DECAY LEVELS IN ^{170}Lu. I. Dzhelepov, B. S.; Ter-Nersesyants, V. E.; Shestopalova, S. A. (All-Union Scientific Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1633-46(Oct. 1967). (In Russian).

The energy levels in ^{170}Yb were investigated using the decay of ^{170}Lu. The energy and relative intensities of transitions in ^{170}Yb were determined. A partial decay scheme for ^{170}Lu is proposed in which the observed transitions are incorporated. (D.C.W.)

35354 ALPHA-DECAY OF Dy, Tb, Gd, AND Eu ISOTOPES. Golovkov, N. A.; Gromov, K. Ya.; Lebedev, N. A.; Makhmudov, B.; Rudnev, A. S.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1618-22 (Oct. 1967). (In Russian).

A magnetic α spectrometer was used for measuring the α spectra of the Dy, Tb, Gd, and Eu isotopes prepared by irradiation of tantalum and erbium targets with 660-MeV protons. Tabulated data on α spectra and tracks for ^{150}Dy, ^{151}Dy, ^{152}Dy, ^{153}Dy, ^{154}Dy, ^{147}Eu, ^{148}Gd, and ^{149}Gd are included; decay schemes are given for ^{153}Dy, ^{149}Gd, ^{149}Tb, and ^{151}Tb. (R.V.J.)

35355 ^{242}Cm. Berger, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Newslett. Isotop. Generator Inform. Centre, No. 5, 5-8(Mar. 1968).

The nuclear properties of ^{242}Cm and the physical properties of Cm_2O_3 and Cm_5Au are summarized, and methods for preparation of ^{242}Cm are outlined. Possible uses of ^{242}Cm are discussed on the basis of the physical properties of the isotope. (D.C.W.)

35356 CONVERSION ELECTRON SPECTRA AND DECAY MODES OF ISOTOPES ^{181}Os, ^{180}Os, AND ^{178}Re. Belyaev, B. N.; Gudov, V. I.; Krizhanskii, L. M.; Usikov, B. S. Yadern. Fiz., 7: 720-6(Apr. 1968). (In Russian).

Conversion electron spectra from decays of isotopes ^{181}Os, ^{180}Os, and ^{178}Re are investigated by means of the Si(Li) detector. The conversion coefficients of the following transitions are measured: ^{181}Os–118 ($\alpha_K = 4$), 166 ($\alpha_K = 1.4$), 238 ($\alpha_K = 0.1$) and 820 keV ($\alpha_K = 9 \times 10^{-3}$); $^{180}\mathrm{Os} \rightarrow {}^{180}\mathrm{Re} \rightarrow {}^{180}\mathrm{W}$–826 ($\alpha_K = 2.6 \times 10^{-2}$), 900 ($\alpha_K = 5.5 \times 10^{-3}$) and 1004 keV ($\alpha_K > 0.1$); ^{178}Re–238 keV ($\alpha_K = 0.12$). Comparing the experimental values of α_K and K/(L + M) with theoretical values by Sliv, the transition multipolarities are determined. On basis of the obtained data on the conversion spectra and on the γ spectra, decay modes for the isotopes ^{181}Os, ^{180}Os, and ^{178}Re are presented. (auth)

35357 RELATIVE DETERMINATION OF ENERGIES OF THE MOST INTENSE α-PARTICLE GROUPS FOR SOME ISOTOPES ($T_{1/2} > 50$ YRS) OF HEAVY ELEMENTS. Baranov, S. A.; Kulakov, V. M.; Shatinskii, V. M. Yadern. Fiz., 7: 727-32(Apr. 1968). (In Russian).

The results of relative measurements of the energy of intense α groups are given for eleven isotopes of heavy elements. The energy values for 23 α lines are presented. Evidence is given that there exist 3 unknown α groups in the ^{231}Pa spectrum with energies of about 5031, 5027, and 5009 keV. The measurements were performed by means of a magnetic α spectrograph. (auth)

35358 RESONANCE SCATTERING OF ^{191}Ir γ RAYS WITH ENERGY 129 keV. Davydov, A. V.; Kartashov, G. R.; Khrudev, Yu. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 735-42(Apr. 1968). (In Russian).

The angular distribution of 129-keV γ rays from resonance (Moessbauer) scattering on ^{191}Ir nuclei was measured. The data obtained are used to determine the magnetic moment of the ^{191}Ir excited state at 129 keV from the measured rotation angle of the scattered γ-quanta angular distribution in the 24.5-kOe magnetic field. The magnetic moment was found to be 3.00 ± 0.58 nuclear magneton. The multipole mixing parameter was determined for the 129-keV transition: $\delta = +0.398 \pm 0.020$. (auth)

35359 INVESTIGATION OF THE ^{131}Ba DECAY. Kutsarova, T.; Kratsik, B.; Zvol'ska, V. (Inst. of Nuclear Research, Rez, Czech.). Yadern. Fiz., 7: 713-19(Apr. 1968). (In Russian).

Using two Ge(Li) detectors, the γ-ray spectrum of ^{131}Ba following the electron capture with the half-life 11.5 days was studied. New transitions in ^{131}Cs with the energies 508 ± 3 and 563 ± 2 keV were found. For the levels 133.54, 585.1, and 620.2 keV, the quantum numbers $5/2^+$, $3/2^+$, and $1/2^+$, respectively, were proposed. The results are compared with the model by Kisslinger and Sorensen. (auth)

35360 INFLUENCE OF INTERMEDIATE STATES OF THE FISSILE NUCLEUS ^{233}Th ON MASS AND KINETIC ENERGY DISTRIBUTIONS OF FRAGMENTS. Sergachev, A. I.; Vorob'eva, V. G.; Kuz'minov, B. D.; Mikhailov, V. B.; Tarasko, M. Z. Yadern. Fiz., 7: 778-84(Apr. 1968). (In Russian).

The mass and kinetic energy distributions of fragments from the fission of ^{232}Th by neutrons with energies of 1.38, 1.51, 1.65, 1.90, 2.37, 2.87, and 5.6 MeV were investigated. At transitions in the neutron energy from $E_n = 1.51$ MeV to $E_n = 1.65$ MeV, the mass and the energy distributions are essentially changed. At $E_n = 2.87$ MeV, the yields of symmetric fragments increase substantially. The effects observed are ascribed to the influence of intermediate states of the fissionable nucleus. (auth)

35361 COEFFICIENTS OF INTERNAL CONVERSION ON THE K-, L-, AND M-SHELLS OF THE ATOMS Hg AND Tl. Trusov, V. F. (Latvian State Univ., Riga). Yadern. Fiz., 7: 785-7(Apr. 1968). (In Russian).

Coefficients of the internal conversion on the K-, L-, M_{I-III}-shells of the Hg atom and on the M_{I-III} shells of the Tl atom for electric and magnetic transitions of the two first multipolarities are calculated. The nuclear field screening was taken into account by means of the potential obtained by the method of relativistic consistency considering the Slater method exchange $\langle\rho^{1/3}\rangle$. (auth)

Nuclear Theory

Refer also to abstracts 33668, 34287, 34868, 34926, 35216, 35219, 35226, 35233–35236, 35240, 35241, 35247, 35248, 35251, 35285, 35291, 35293, 25311, 35316, 35319, 35320, 35323, and 35337.

35362 (AD-662219) MODELISTIC AND REALISTIC INTERACTIONS IN THE 1p, 2s–1d, AND 2p–1f NUCLEAR SHELLS. Final Report. De Llano, Manuel (Naval Research Lab., Washington, D. C.). Oct. 17, 1967. 43p. (NRL-6640). CFSTI.

The excitation spectra and beta-decay comparative half-lives of ^{6}He, ^{6}Li, ^{18}O, ^{18}F, ^{42}Ca, and ^{42}Sc are calculated using a modelistic interaction containing pairing plus quadrupole-quadrupole operators (with Rosenfeld exchange), single-body spin-orbit, and long-range tensor interactions. The resulting low-lying wave functions are compared to those obtained by other workers with hard-core realistic interactions and are found to overlap to a high degree. (auth)

35363 (AD-665366) THE MATHEMATICAL DESCRIPTION OF THE N-NUCLEON SYSTEM BASED ON TWO-NUCLEON POTENTIAL. Loder, Rurik K. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Jan. 1968. 50p. (NDL-TR-101). CFSTI.

The S-matrix for the N-nucleon system with initial and final boundaries is written as a proper combination of wave functions corresponding to the states of the N-nucleon system at the times t = negative-infinity and t = infinity. The calculation of the wave functions, obeying the Schrodinger equation, is accomplished with the aid of a reasonable approximation of the two nucleon potential derived by Hamada and Johnston. (auth)(USGRDR)

35364 (GEPP-34) TECHNIQUE FOR STUDYING ION BEAMS OF OPERATING NEUTRON TUBES. Peters, R. D. M. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). May 13, 1968. Contract (29-2)-656. 4p. (R-68-ND-11). Dep. CFSTI.

Previous ion beam focusing studies in neutron tubes relied primarily on photographs of phosphor targets or autoradiographs to determine beam configuration. A new technique for studying ion beams of operating neutron tubes is described. This technique may be used: (1) to study tubes that have been baked out to less than 400°C, (2) to produce neutrons, and (3) to provide unique information on the configuration of the ion beam for each shot. (auth)

35365 (ORNL-4217) ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1967. Howard, F. T. (ed.) (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 172p. Dep. CFSTI.

Separate abstracts were prepared for the five sections of the report. (D.C.W.)

For abstracts of individual sections see: 33684, 35174, 35175, 35292, and 35366.

35366 (ORNL-4217, pp 82-95) NUCLEAR PHYSICS THEORY. (Oak Ridge National Lab., Tenn.).

Theoretical research continued to center around applications of the Oak Ridge–Rochester shell-model code. Two studies in the s-d shell were carried out. In one case, the shell-model Hamiltonian was determined empirically by fitting certain observed energy levels in A = 20 to 28 nuclei. In a second line of study on A = 19 to 22 nuclei, the shell-model basis space was enlarged to include $1d_{3/2}$ states, and the model Hamiltonian was derived from the Hamada–Johnston nucleon–nucleon potential. A program of studies to test the validity of the Watson–Migdal theory of final-state interactions was initiated. (D.C.W.)

35367 ^{8}Be FRAGMENTS EMITTED FROM HIGH-ENERGY NUCLEAR DISINTEGRATIONS. Wang, Ke-ming; Li, Hui-xin; Chang, Nai-jian; Qu, Hong-xiang; Sun, Qui-sheng; Shen, Yu-lin; Su, Quan-zheng. K'o Hsueh T'ung Pao, 17: 202-5(Mar. 15, 1966).

The emission of fragments is one of the main characteristic features of high-energy nuclear reactions. The ^{8}Be nucleus, unstable in the ground state, with a very short lifetime of about 10^{-16} sec was studied. It decays, after its production in high-energy nuclear disintegration, into 2 α particles + energy (Q) which is much smaller than the kinetic energy of the ^{8}Be fragment. The 2 α particles produced form 2 tracks of nearly equal range in the emulsion, with a very small angle between them. To select ^{8}Be fragments for study, various selection criteria have been employed by different authors. In all previous works, selection of events was made on the basis of certain fixed angles without making proper allowance for such specific conditions as the energy of ^{8}Be fragment and the magnitude of the dip. To avoid loss of events, a somewhat larger Q-value ($Q \le 0.25$ MeV) was used for preliminary inspection, and nondesirable events were ruled out by detailed measurements and calculations. The criteria adopted were: the 2 tracks were produced from primary stars of heavy nucleus ($N_h \ge 8$) and both come to rest within the same plate; the space angle between the 2 tracks is relatively small; the energies of the 2 α particles are about equal; and the charges, Z, of both tracks are taken as 2. On the basis of the experimental results and their interpretation, it was tentatively concluded that most ^{8}Be fragments are produced during the evaporation process. The main characteristic features of these fragments (energy and angular distributions) do not contradict the evaporation model. (BBB)

35368 DISINTEGRATION OF HEAVY NUCLEI AT ELEVATED TEMPERATURES. Suess, H. E. (Univ. of California, La Jolla); Zeh, H. D.; Jensen, J. H. D. Heidelberg. Akad. Wiss. Math.-Naturwiss. Kl., Sitzungsber., No. 3, 73-82(1967). (In German).

Calculations and tabulations of particle emission rates of heavy nuclei at temperatures in the range of 10^9 °K are presented. The possible importance of these neutron, proton, and α emissions and of the abundance distributions on the formation of the nuclei is discussed on the basis of the results. (IIA)

35369 NUCLEAR FISSION. de Mevergnies, Neve (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Rev. Quest. Sci., 135: 201-22(Apr. 1967). (In French).

Studies of nuclear fission are reviewed. The theory of the liquid drop model is developed. This is applied to several elements, with emphasis on ^{235}U, whose decay scheme is tabulated in detail. The problem of mass distribution of fission products is discussed; theoretical approaches based on the drop model are outlined. The concept of the series of barriers to fission is outlined; methods for experimental verification of such hypotheses are sketched, with particular emphasis on the study of resonances in nuclei fissioning by absorption of neutrons. The study of spontaneous fission by heavy nuclei is reviewed; and the correlation of magic numbers with decay constants is demonstrated. Minimum observed lifetimes are noted, and the observation of increasing lifetimes after passing through a minimum leads to the proposal that ^{298}114 can be prepared. (BBB)

35370 INELASTIC ELECTRON SCATTERING FROM NUCLEAR MATTER. Beil, R. G.; Kuemmel, H. (Max-Planck-Institut fuer Chemie, Mainz). Z. Phys., 212: 248-65(1968).

The response function, which is directly related to the cross section for inelastic scattering of electrons from nuclear matter, is calculated with the help of a time-dependent perturbation theory using a separable potential. All diagrams through second order in the interaction are computed and their contributions compared. The self-energy problem is examined, and it is concluded that a Hartree–Fock approximation is preferable to one which attempts to take K-matrix insertions into account. Results for the response function are compared with those of previous workers. (auth)

35371 SINGLE-PARTICLE CALCULATIONS IN FISSION THEORY. Benewitz, Julius; Haug, Peter K. (Univ., Frankfurt am Main). Z. Phys., 212: 295-307(1968). (In German).

An axial symmetric, energy-, spin-, and isospin-dependent shell-model Hamiltonian is used to describe heavy deformed nuclei, where the equipotential surfaces are taken to be spheroids, corrected towards a more realistic nuclear shape by means to

Legendre polynomials of maximal order four, and the potential is assumed to depend on the modified radial coordinate like a Fermi function. The eigenvalue problem is solved by a perturbation treatment which starts with the eigensolutions for purely spheroidal deformations as a first approximation. By analysis of an expression which involves the single-particle energies for a given deformation, the sets of deformation parameters for the ground state and the transition point of a fissioning nucleus are found; and from them the total energy at the transition point is obtained. For ^{231}Th, ^{233}Th, ^{235}U, ^{236}U, and ^{237}U, results are given and are compared with measurements and liquid drop model calculations (auth)

35372 NUCLEAR MODELS AND EXCITATION ENERGIES. Dutta, A. K. (Calcutta Univ.). Progr. Theor. Phys. (Kyoto), 39: 1069-70(Apr. 1968).

An interpretation of the correlation of fluctuations, with nucleon numbers, of the different excitation energies and the neutron-proton exchange energy of strongly bound odd-mass and even-even nuclei in isobaric sets is outlined. It is noted that any nuclear model should be able to explain both the systematics of the exchange energy and the systematics of the excitation energies. (D.C.W.)

35373 THEORY OF THE EXCITED-CORE NUCLEAR MODEL. Thankappan, V. K. (Tata Inst. of Fundamental Research, Bombay). Progr. Theor. Phys. (Kyoto), 39: 985-99(Apr. 1968).

A microscopic version of the excited-core model is presented on the basis of the concept that an odd-mass nucleus of mass number (A−1) might be described as a particle with respect to the even-even nucleus of mass number (A−2) and a hole with respect to the even-even nucleus of mass number A. It is shown that the equations would reduce to the equations of the single-particle shell model or to those of the quasiparticle model under the imposition of the appropriate approximations. (auth)

35374 PAULI PRINCIPLE AND REARRANGEMENT COLLISIONS IN UNIFIED THEORY OF NUCLEAR REACTIONS. Efimenko, T. G.; Zakhariev, B. N.; Zhigunov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Ann. Phys. (N. Y.), 47: 275-84(1968).

A new method is suggested to describe rearrangement collisions in the framework of the unified theory of nuclear reactions. This method allows also to take into account the exclusion principle and to treat the reactions with the number of fragments $n \geq 3$. The problem is reduced to the solution of a system of inhomogeneous differential equations and of a simple system of linear algebraic equations. Thus it is possible to investigate the strong coupling between channels with different composition of fragments when perturbation theory is not correct. The well-known difficulty of treating the rearrangement processes is avoided by using a truncation procedure to "undesirable" components of the wavefunction Ψ. (auth)

35375 EIGENCHANNEL THEORY FOR ELECTRON SCATTERING. Toepffer, Christian; Greiner, Walter (Univ. of Virginia, Charlottesville. Univ., Frankfurt am Main). Ann. Phys. (N. Y.), 47: 285-307(1968).

The eigenchannel theory of nuclear reactions has been generalized to the case of electron scattering. The generalization is twofold. First, the spinor character of the electron wavefunctions has been incorporated into the theory; and, second, the special features arising from the long-range Coulomb interaction are carefully discussed. The dispersion effects in electron scattering are easily formulated in this framework. Formulas for elastic and inelastic electron scattering cross sections including these second- and higher-order effects are derived. It is shown that the eigenphases are not very different from the potential phases; and, consequently, the computer search procedure for eigenphases is considerably simplified. (auth)

35376 EFFECTIVE, CENTRAL, DENSITY-DEPENDENT POTENTIAL FROM TENSOR FORCE IN NUCLEAR MATTER. Bhaduri, R. K.; Warke, Chindhu S. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett., 20: 1379-82(June 10, 1968).

A local, central, density-dependent potential is derived from a given two-nucleon tensor force in nuclear matter. Such an effective force can be used in finite-nuclei calculations in place of the tensor force to determine the gross properties of nuclei. (auth)

35377 EXPRESSIONS FOR THE TRANSMISSION COEFFICIENTS AND THE MEAN SQUARE DEVIATION OF THE ELASTIC-SCATTERING CROSS SECTION. Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett., 20: 1510-13 (June 24, 1968).

An expression for the transmission coefficient for the general case of an arbitrary number of open channels, valid for all values of the ratio of the average partial width to the average spacing, is obtained from a completely unitary matrix. For the purely elastic-scattering case, the average value and the mean-square deviation of the elastic-scattering cross section are expressed in terms of the potential-scattering phase shift and the ratio of the average width to the average spacing. (auth)

35378 NEW DYNAMIC EFFECT IN MUONIC ATOMS. Henley, E. M.; Wilets, L. (Univ. of Washington, Seattle). Phys. Rev. Lett., 20: 1389-92(June 10, 1968).

For certain nuclear species, it is possible to use the studies of muonic x-ray transitions to investigate nuclear Coulomb monopole transition matrix elements. The case of $0^+ - 0^+$ vibrational excitation is treated in detail as an example. (auth)

35379 SHELL EFFECTS AND DEFORMATION OF FISSION PRODUCTS. Geilikman, B. T.; Khlebnikov, G. I. Yadern. Fiz., 7: 215-6(1968). (In Russian).

Experiments on the fine structure of the mass distribution of the fission products as a function of excitation energy indicate the importance of shell effects. The energy of a fissioning nucleus before separation into two parts can be represented in the form of the following sum: the energies of spherical fission products with shell effects being taken into account, the energy of the Coulomb interaction of the fission products, and the energy of deformation of the fission products. In calculating the deformation energy it is necessary to use fission product elasticities not from the drop model, but rather single-particle values of the elasticity with magic effects being taken into account (at small deformations) with a gradual transition to drop values of the elasticity at deformations where the levels of neighboring shells intersect. The magnitude of the deformation is estimated for a number of fission product pairs during ^{235}U fission on the assumption of a minimum of the Coulomb and deformation energies. Asymmetric fission is shown to be energetically favorable. (TTT)

35380 PARITY-NONCONSERVING NUCLEAR FORCES. McKellar, Bruce H. J. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett., 20: 1542-5(June 24, 1968).

The effective single-particle weak parity-nonconserving potential is recalculated including parity-nonconserving one-pion exchange forces and the two-body correlations induced by the hard cores in the nucleon-nucleon potential. The circular polarization of the γ ray from the 482-keV transition in ^{181}Ta is calculated to be $-(0.2 \pm 0.1) \times 10^{-4}$ The measured value is $-(0.06 \pm 0.01) \times 10^{-4}$, showing that the observed parity nonconservation in nonleptonic $\Delta S = 0$ transitions is in agreement with the Cabibbo theory of weak interactions. (auth)

35381 ON THE TRANSITIONS BETWEEN SENIORITY-FOUR AND SENIORITY-TWO STATES COMPARED TO THE TWO-PHONON-ONE-PHONON TRANSITIONS. Arvieu, R. (CNRS, Orsay, France); Moszkowski, S. A. Nucl. Phys., A114: 161-83 (1968).

Using the generalized quasi-spin representation, sum rules are derived for the electric quadrupole transition rates connecting the first 2^+ state of seniority two and states of various seniority ($v = 2 \rightarrow v = 4$). It is shown that the sums over states of seniority four approach the vibrational sum rule for large degeneracies. In several cases, individual transitions have been calculated for a surface delta interaction. When the single-particle states are degenerate, it is shown that 0^+, one 2^+, and one 4^+ exhaust almost entirely the $v = 2 \rightarrow v = 4$ sum rule. A calculation is also performed of these transitions in a case where the single-particle energies are no longer degenerate. Here there is some mixing between seniority-2 and -4 states, and the picture concerning transition rates is more complicated. (auth)

35382 ODD-PARITY STATES IN THE A = 6 AND 14 SYSTEMS. Cooper, Benjamin S. (Iowa State Univ., Ames); Eisenberg, J. M. Nucl. Phys., A114: 184-210(1968).

Odd-parity excitations for the A = 6 and 14 nuclei are calculated within the framework of the particle-hole shell model with a consistent treatment of core-excited configurations as well as excitations which affect only extra-core particles. For A = 6, this basis is composed of two-particle and three-particle/one-hole configurations. The basis for the A = 14 problem is composed of two-hole and three-hole/one-particle configurations. Spherical harmonic oscillator radial functions are used, and the spurious content of the basis is removed. A finite-range gaussian residual interaction with Wigner, Majorana, Heisenberg and Bartlett exchange components is diagonalized in the non-spurious subspace. The resulting eigensolutions are used to obtain absolute dipole strength distributions for these nuclei. These distributions and the calculated level spectra are compared with the experimental data. (auth)

35383 HARTREE–FOCK PROBLEM WITH SUBSIDIARY CONDITIONS AND THE RANDOM PHASE APPROXIMATION. **Mann, A.; Unna, I. (Hebrew Univ., Jerusalem). Phys. Lett., 27B: 72-5(June 10, 1968).**

When one requires a particular form for the energy change of the Hartree-Fock ground state while imposing subsidiary conditions, one is led to the random phase approximation equations. The relation between the stability of the unconstrained Hartree–Fock ground state and the reality of the random phase approximation eigenvalues is an immediate consequence. (auth)

35384 NUCLEAR MOMENTS AND ISOMERIC SHIFT OF SHORT-LIVED NUCLEAR LEVELS BY RESONANT SCATTERING. **Eicher, H. (Technische Hochschule, Munich). Z. Phys., 212: 176-82(1968). (In German).**

In a resonant scattering experiment, the perturbation of the angular distribution by a magnetic field perpendicular to the scattering plane depends, due to the finite bandwidth of the incident gamma-ray, on the spins and parities of both nuclear levels and on the mixing ratio of the γ transition. It is shown that for certain conditions, however, this dependence can be neglected and one finds a situation similar to the perturbed $\gamma-\gamma$ angular correlation. These conditions are: the lifetime τ of the excited nuclear state must be short enough so that the perturbation can be neglected in second order, and the source must not be moving relative to the target. The influence of the quadrupole interaction on the angular distribution is calculated up to second order for a $0^+ \rightarrow 2^+$ E2 transition. It is shown, that in contrast to the perturbed $\gamma-\gamma$ angular correlation, the sign of the quadrupole interaction can be measured in the case of resonant scattering from a single crystal, because the perturbation is of first order provided the incident gamma ray is Doppler-shifted. (auth)

35385 HARTREE–FOCK CALCULATIONS FOR FINITE NUCLEI WITH EQUIVALENT NONLOCAL POTENTIALS. **Roehl, W. H.; Stocker, W. (Univ., Koeln, Ger.). Z. Phys., 212: 477-96 (1968).**

The method of constructing equivalent regular two-body potentials by a unitary transformation of the two-body Hamiltonian was generalized to spin-parity-dependent nuclear potentials containing tensor- and spin-orbit terms. Starting from the Gammel-Christian-Thaler potential, which includes tensor forces, a class of equivalent regular, but nonlocal potentials depending on a parameter λ, the range of nonlocality, was obtained. These potentials were used in a Hartree-Fock calculation for the closed-shell nuclei ^{4}He, ^{12}C, ^{16}O, ^{28}Si, ^{32}S, ^{40}Ca. The calculated binding energies show a slow λ-variation with a minimum in the region of 0.7 f. The nuclear radii decrease with increasing λ and are in general too small. The sequence of single-particle levels of the nuclei with closed l-shells is in agreement with that obtained with the usual nuclear shell model potential including spin-orbit coupling. (auth)

35386 GAMMA-RAY CALIBRATION ENERGIES. **Marion, Jerry B. (Univ. of Maryland, College Park. California Inst. of Tech., Pasadena). Nucl. Data, Sect. A, 4: 301-19(May 1968).**

A tabulation is given of γ-ray energies which are suitable for calibrating high-resolution γ-ray spectrometers. Data from studies of both radioactive sources and nuclear reactions are included, allowing precision calibration in the range 25 keV < E_γ < 11 MeV. (auth)

35387 COMPARATIVE STUDY OF TWO-PARAMETER MODELS FOR PREDICTING ROTATIONAL ENERGIES IN EVEN–EVEN NUCLEI. **Sood, P. C. (Univ. of Alberta, Edmonton). Nucl. Data, Sect. A, 4: 281-300(May 1968).**

An objective comparison of the various two-parameter models proposed for the description of rotational states in even-even nuclei is carried out to assess the reliability of their extrapolation for prediction of as yet unobserved levels. The comparison involving energy ratios E(I)/E(2) contains no arbitrarily adjustable parameters. The semiempirical formula $E(I) = A\{1 - [(B/A)I(I+1)/1 + N(B/A)I(I+1)]\}I(I+1)$ is seen to give the best fit. A least-squares fit to observed levels with this formula gives a rms deviation of better than 0.5% in nearly all cases. The calculated values of the rotational constants A and B, and the predicted energies of rotational levels with spin up to I = 16 are tabulated. (auth)

35388 A CALCULATION OF THE PRODUCTION OF PIONS BY 450-MeV PROTONS ON NUCLEI. **McMillin, D.; Bhargava, P.; Lam, L.; Vogt, E. W. (Univ. of British Columbia, Vancouver). Can. J. Phys., 46: 1141-4(May 1, 1968).**

Starting with assumed pion yields in nucleon-nucleon collisions, the influence of the various nuclear effects on the pion yields from the bombardment of various nuclei with 450-MeV protons is considered. In addition to the proton and pion absorption within the nucleus considered by earlier workers, the effects of the momentum distribution and the density distribution of the struck nucleons are also included. The pion absorption, which is density-dependent, is found to dominate the relative yields in various nuclei at these proton energies, using modern densities. Agreement with the measured relative yields is obtained as illustrated with the results for pion angle of 21.5° and pion energy of 83 MeV. (auth) (Canada)

35389 CORRELATION BETWEEN THE KINETIC ENERGY OF FISSION PRODUCTS AND THE EXCITATION OF THE FISSIONING NUCLEUS. **Geilikman, B. T. Yadern. Fiz., 6: 1111-12 (Nov. 1967). (In Russian).**

The kinetic energy of the fission products in threshold fission reaches a minimum value in the case of symmetric fission and a maximum within the most probable fission range, decreasing with further increase of the asymmetry. The depression in the kinetic energy, E_k, is attributed to the shell effect of the newly formed fragments. It may be due to the temperature dependence of the viscosity of the nuclear liquid which according to Landau's theory follows the $1/T^2$ law. When the excitation energy of the fissioning nucleus is increased, as a result of the decrease of the viscosity with the temperature, the neck is broken at a higher thickness, or reduced length, resulting in an increase of the kinetic energy of the fission products. This qualitative explanation must be supplemented by hydrodynamic calculations. A study of ternary fission indicates on the basis of probability calculations that the energy relations of the binary and ternary fission phenomena are expressed by $E_t < E_b$. (TTT)

35390 EFFECTIVE MASS B_2 AND STIFFNESS PARAMETER C_2 FOR QUADRUPOLE VIBRATION IN EVEN–EVEN SPHERICAL NUCLEI. **Wong, C. Y. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. A, 4: 271-80(May 1968).**

Values of the effective mass B_2 and the stiffness parameter C_2 for quadrupole vibration of even-even spherical nuclei have been computed from the B(E2) values and energies of first 2^+ states adopted by Stelson and Grodzins. A comparison of these with values predicted by a liquid-drop model shows B_2 an order of magnitude larger than the predictions. The value of C_2 is usually less than the prediction but at magic numbers is many times greater. (auth)

35391 REDUCTION OF U_6 REPRESENTATIONS INTO SU_3 IRREDUCIBLE COMPONENTS. **Perez, R. (Univ., Mexico City); Flores, J. Nucl. Data, Sect. A, 4: 265-70(May 1968).**

A table of the SU_3 representations contained in a given Young diagram specifying the irreducible representations of the orbital group U_6 is constructed for all possible partitions in the 2s-1d shell. (auth)

35392 AVERAGE NUMBER AND ENERGY OF PROMPT NEUTRONS FROM FISSION. **Kluge, Gy.; Lajtai, A. (Central Research Inst. for Physics, Budapest). Phys. Lett., 27B: 65-8(June 10, 1968).**

The initial temperatures corresponding to the excitation energies of individual fission fragments are predicted to a fair accuracy from a simple statistical model. These values are then used for the evaluation of the average number and energy of the neutrons emitted per fragment. (auth)

35393 ALPHA-DECAY RATES IN HEAVY NUCLEI. **Scherk, L.; Vogt, E. W. (Univ. of British Columbia, Vancouver). Can. J. Phys., 46: 1119-28(May 1, 1968).**

The alpha-decay rates in heavy nuclei are analyzed by a method in which the decay rates are factored into one-body widths and spectroscopic factors. It is shown that the discrepancy between the absolute values of the experimental alpha-decay rates and those calculated with the nuclear shell model has mainly resided in the incorrect assessment of the one-body widths and that it can be largely removed by a more direct treatment of the average interaction between the alpha particle and the residual nucleus. (auth) (Canada)

35394 VARIATION OF NEUTRON YIELD WITH FRAGMENT MASS IN FISSION. **Gorman, D. J.; Tomlinson, R. H. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 46: 1137-9(May 1, 1968).**

A semiempirical method is developed for constructing neutron-yield curves based on Terrell's "universal" curve and the postulate of Glendenin (1949). The curves so constructed, when combined with the prompt yields, will reproduce the fine structure in the cumulative yields. (auth) (Canada)

35395 ALPHA DECAY TO VIBRATIONAL LEVELS IN ODD-ODD DEFORMED NUCLEI. **Dumitrescu, O.; Sandulescu, A. (Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 265, 8p(Jan. 1968).**

The influence of the residual interaction between quasiparticles, and phonons on alpha decay rates in odd-odd deformed nuclei is analyzed. It is shown that this interaction gives rise to alpha transitions of mixed quasiparticle and collective character. An expression for the decay constant is given explicitly. (auth)

35396 SHELL-INDEPENDENT SYSTEMATICS S_n (ISOTONIC) AND S_p (ISOTOPIC). Gove, N. B. (Oak Ridge National Lab., Tenn.); Yamada, M. Nucl. Data, Sect. A, 4: 237-63(May 1968).

Graphs are presented of recent values for the separation energy of a given neutron versus mass number, S_n (isotonic, and for a given proton versus neutron number, S_p (isotopic). The graphs confirm the fact, pointed out by Yamada and Matumoto in 1961, that the separation energy of the nth proton increases monotonically (except for odd-even effects) as the neutron number is increased, showing little, if any, discontinuity at magic neutron numbers. An analogous statement can be made for the separation energy of the nth neutron as the proton number is increased. Extrapolation by means of the graphs should, therefore, be particularly reliable since it is essentially magic-number independent. Data available in the summer of 1967 have been considered. (auth)

35397 INTERNAL PAIR FORMATION IN NUCLEAR β-PROCESSES. Richards, Keith Carlton. Charlottesville, Va., Univ. of Virginia, 1967. 95p.

Thesis.

In the β decay of ^{90}Y and ^{16}N, branching ratios for the first excited state can be determined by observing the pairs which are emitted when this excited state decays to the ground state. This is the case for both the excited state and the ground state have $J^\pi = 0^+$. There is a possibility that this determination may be complicated by internal pair formation accompanying the ground-state β decay. This process has been calculated. It has been found that the ratio of pairs from the decay of the excited state to pairs from internal pair formation accompanying the ground-state β decay is 5.9×10^3 in ^{90}Y and 1.6×10^2 in ^{16}N. For the sake of completeness, and in view of its relative theoretical simplicity, internal pair formation in K-capture has also been calculated. A typical result is that for ^{210}At. Here the ratio of positrons from positron decay to positrons from internal pair formation accompanying K-capture is 5.0×10^3. The relative contribution of the detour transitions of R. R. Lewis, Jr., and G. W. Ford to the total decay rate characterizing these internal processes is discussed. (Disser. Abstr.)

35398 ON THE BOUND STATE OF TWO AND THREE NUCLEONS IN NUCLEAR MATTER. Sitenko, A. G.; Kharchenko, V. F.; Shadchin, S. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 588-98(Apr. 1968). (In Russian).

The problem of the bound state of two and three nucleons in nuclear matter is considered. The nucleon interaction is described by a nonlocal separable potential. On the basis of the Bethe–Goldstone equation, the properties of a bound state of a nucleon pair in nuclear matter are studied with account for the Pauli principle. When the total momentum of the three-nucleon system equals to zero, calculation of the wave function and the bound-state energy is reduced to the solution of a homogeneous system of one-dimensional integral equations. The dependence of the binding energy on the density of nuclear matter is found for two-nucleon potentials of a different form. (auth)

35399 THEORY OF DIRECT NUCLEAR KNOCK-OUT REACTIONS WITH POLARIZED BEAMS. McRary III, J. W.; Park, J. Y. (North Carolina State Univ., Raleigh). Contract AT(40-1)-3624. Nuovo Cim., 55B: 525-38(June 11, 1968). (ORO-3624-2).

A previous statement of the theory of direct nuclear knock-out reactions is generalized to include reactions involving the exchange of two-fermion clusters and reactions involving polarized incident beams. The formalism is developed in terms of the distorted-wave Born approximation. Spin-dependent distortions and a finite-range direct interaction are included, but kinematical considerations are neglected assuming the infinitely heavy core for the target and residual nuclei. Coulomb effects, neglected in the previous paper, are taken into account in the present treatment. For cases of the incident beam being unpolarized and polarized, explicit expressions are obtained for the angular distribution, the total cross section, and the polarization of the emitted particles. (auth)

35400 CURVE-FITTING IN THE OPTICAL MODEL. Hoegaasen, J. (Institut de Physique Nucleaire, Orsay, France. EPHE, Paris). Nuovo Cim., 55B: 595-9(June 11, 1968).

The failure of the chi square criterion in optical model analyses of data with a strongly oscillatory pattern is studied. (D.C.W.)

35401 CALCULATING THREE-RAY APICAL PARTS. Orlov, Yu. V.; Kaminskii, V. A.; Orevkov, Yu. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 6: 113-5(Nov.-Dec. 1967). (In Russian).

In calculating Feynman diagrams of direct nuclear reactions it is necessary to know the apical parts or the virtual decay or synthesis amplitudes for the reaction $A \rightleftharpoons B + C$. Since the particles A, B, and C may be virtual, the invariant form factor G depends on the three invariants of mass, kinetic energy, and momentum. However, in a model where the interaction between B and C is described by a potential V, the form factor G depends only on q^2, the square of the momentum transfer; and is described by a Fourier transformation of the wave function of the relative motion of B and C. The analytical properties of the invariant form factor $G(q^2)$ were plotted after calculation on a computer for ^{7}Li, ^{13}C, and ^{17}O. (TTT)

35402 METHODS OF DETERMINING INTERNAL MAGNETIC FIELDS. Broda, Rafal (Instytut Fizyki Jadrowej, Krakow). Postepy Fiz., 19: 157-66(1968). (In Polish).

A review is given of the methods of determining internal magnetic fields now in use. There are detailed descriptions of the following methods: nuclear specific heat, alignment of nuclei at low temperatures, $\gamma-\gamma$ angular correlations, and Coulomb excitation. (auth)

35403 RESULTS OF CERTAIN NON-HERMITIAN HAMILTONIANS. Wong, Jack (Univ. of California, Livermore). J. Math. Phys. (N. Y.), 8: 2039-42(Oct. 1967).

A few results on the spectral properties of a class of physically reasonable non-Hermitian Hamiltonians are presented. These theorems relate the spectral properties of a non-self-adjoint operator (of the aforementioned class) in terms of that of a self-adjoint operator. These theorems can be specialized to yield conditions under which the perturbed eigenvalues (of the above class of operators) vary continuously from the eigenvalues of the unperturbed operators. If the Schroedinger equation has to be solved numerically, a knowledge of the spectral properties of the non-Hermitian Hamiltonian would insure when the eigensolutions exist. (auth)

35404 PROPERTIES OF SOME COLLECTIVE AND TWO-PARTICLE ISOMERIC STATES IN SPHERICAL EVEN–EVEN NUCLEI. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1584-99(Oct. 1967). (In Russian).

The discovery of the even-even spherical nuclei $^{120-130}$Xe, ^{150}Sm, ^{152}Gd, and $^{182-190}$Pt with quasirotational bands evoked new interest in the properties of the collective and two-quasiparticle states of spherical even-even nuclei. The presence of such bands indicate that basically spherical nuclei may become deformed during excitation (especially when they acquire a large angular moment $I \geq 4$). It is also possible to anticipate that the transitions from the two quasiparticle state with a large spin to the upper band level, related to the strong variations of K, should be K-forbidden or hindered significantly. In order to resolve the above problems, an attempt was made to evaluate the experimental data on the so called two-phonon triplets. It is suggested that in a large number of spherical even-even nuclei such triplets are absent and the levels present are, in fact, the quasirotational bands. The phenomena attesting to the existence of the K-forbidden transitions in spherical ground-state nuclei are discussed. The analogy of the γ vibrational level with $I^\pi = 2^+$ in ^{140}Ce nuclei and isomers of even-even nuclei with N = 78 and 80 and Z = 80 is introduced in the discussion. (R.V.J.)

35405 EFFECT OF STATE MIXING ON THE DIFFRACTION SCATTERING CROSS SECTION. Tishchenko, B. I.; Mel'nik, Yu. N. Yadern. Fiz., 7: 808-14(Apr. 1968). (In Russian).

Analytical expressions for cross sections of diffraction scattering of nuclear particles by atomic nuclei are obtained by the complex angular momenta method for the case of mixing of vibrational states. It is shown that the mixing of states with a different number of phonons results in the variation of oscillation periods in the phase shift and in the change of absolute values of the diffraction scattering cross section as compared with the case of excitation of corresponding pure states. It is shown that the analysis of experimental data on the diffraction cross section allows one to determine absolute values and relative signs of mixing coefficients. The mixing coefficients of one- (5.5 MeV) and two-phonon (2.47 MeV) 4^+ states of the nucleus ^{58}Ni are estimated. (auth)

35406 EXCITATION OF COLLECTIVE STATES IN NUCLEI AT DIFFRACTIONAL DISINTEGRATION OF DEUTERONS. Berezhnoi, Yu. A. Yadern. Fiz., 7: 815-19(Apr. 1968). (In Russian).

Expressions for the differential and integral cross sections of scattering and disintegration of deuterons with excitation of collective one-phonon states in the target nuclei are obtained in the adiabatic approximation on basis of the simple model that allows one to consider the deuteron-nucleus interaction as an inelastic scattering of a point particle in a nonspherical field. The phase rule is shown to be valid for the differential cross sections, as in the case of a point particle. (auth)

35407 EUCLIDEAN EXPANSION OF THE SCATTERING AMPLITUDE IN NUCLEAR PHYSICS. Cocho, G.; Mondragon, A.; Colon-Vela, M. Rev. Mex. Fis., 17: No. 1, 59-67(1968).

It is shown that there is a close relation between the usual energy-averaged scattering amplitude for elastic nuclear collisions and the Euclidean expansion of the nonrelativistic scattering amplitude. This expansion is the nonrelativistic analogue of the crossed-channel Regge analysis used in relativistic particle physics. (auth)

35408 POSSIBILITY TO TEST THE QUASISTATIC CHARACTER OF THE NUCLEAR FISSION. Shigin, V. A. Yadern. Fiz., 7: 832-4(Apr. 1968). (In Russian).

Mass distributions of fragments from ^{252}Cf at the excitation energies 6 and 21 MeV are given as calculated on basis of the statistical approach to the fission. Contrary to the adiabatic approach, the statistical approach predicts for this nucleus a decrease of the mass yield in the region of symmetric fission, while the excitation energy increases. The experiment with ^{252}Cf will make it possible to establish which of the approaches is correct, as well as to find out whether the fission at low excitation energies is a quasistatic process. (auth)

35409 EXPERIMENTAL RECONSTRUCTION OF THE SCATTERING AMPLITUDE OF SPIN $\frac{1}{2}$ PARTICLES ON SPINLESS NUCLEI IN PRESENCE OF A THREE-PARTICLE CHANNEL. Lazarev, L. M. Yadern. Fiz., 7: 895-8(Apr. 1968). (In Russian).

Nuclear reactions with two open channels a + A and 1 + 2 + 3 are considered. In each of the channels there is a particle with spin $\frac{1}{2}$. The other particles are spinless. It is shown that to reconstruct the elastic scattering amplitude a + A, one should experimentally measure differential cross sections of the reactions A(a,a)A, A(a; 1, 2)3 and the polarizations of particles with spin $\frac{1}{2}$ in these processes. (auth)

35410 PROBLEM OF TWO BODIES INTERACTING WITH NONLOCAL FACTORIZABLE POTENTIAL. Tkebuchava, F.; Chilashvili, G. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 794-802(Apr. 1968). (In Russian).

The problem of two particles interacting with a nonlocal factorizable potential is investigated both with and without the Coulomb repulsion taken into account. The phase shift analysis of the $\alpha\alpha$ scattering at low energies is performed for the case in which the potential energy of interaction between α particles, besides the Yukawa attraction, has a potential wall. The potential parameters are found which reasonably describe experimental data. (auth)

35411 QUADRUPOLE MOMENTS OF SPHERICAL EVEN-EVEN NUCLEI. Bal'butsev, E. B.; Dzholos, R. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 788-93 (Apr. 1968). (In Russian).

Anharmonic corrections to the method of the approximate second quantization are obtained. The static quadrupole moments for ^{98,100,102}Ru, ^{104,106,108,110}Pd, ^{110,112,114,116}Cd, and ^{122,124,126,128,130}Te are calculated. (auth)

35412 ASYMPTOTIC NUCLEAR SPECTROSCOPY. Levintov, I. I.; Ter-Martirosyan, K. A. (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Lett., 27B: 69-71(June 10, 1968).

A problem of nuclei excitation by high energy particles is discussed. It is stated that at high energies of the incident particles, the cross section of the excitation of the nuclear levels for transitions with $\Delta T \neq 0$ must decrease with energy independently of the nature of the levels. Unlike this, the probability for the transition of a nucleus with $\Delta T = 0$ must not decrease asymptotically. (auth)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 33530, 33593, 34015, 34097, and 35207.

35413 (AD–661803) YANKEE REACTOR PRESSURE-VESSEL SURVEILLANCE: NOTCH DUCTILITY PERFORMANCE OF VESSEL STEEL AND MAXIMUM SERVICE FLUENCE DETERMINED FROM EXPOSURE DURING CORES II, III, AND IV. Serpan, Charles Z. Jr.; Hawthorne, J. R. (Naval Research Lab., Washington, D. C.). Sept. 29, 1967. 38p. (NRL–6616). CFSTI.

Charpy V-notch specimens, representative of one of the several heats of A302-B steel forming the Yankee reactor pressure vessel and irradiated as part of the Yankee surveillance program, are tested. Specimens of this particular heat, irradiated in near-core (accelerated) as well as in vessel-wall locations, show more embrittlement than specimens of a reference steel heat of the same nominal A302-B composition irradiated simultaneously in the same surveillance capsules. Those specimens from both the Yankee vessel heat and the reference heat irradiated at the vessel-wall location depict a higher damage rate than that for the accelerated location. The cause of this difference in embrittlement response can not be attributed to an effect of cyclic, service irradiation temperatures, but can be traced to a qualitative relationship of thermal to fast (>1 MeV) neutron fluxes. This ratio is in excess of about 9 : 1 at the vessel-wall location versus a ratio less than about 9 : 1 for the accelerated location. The computation of a maximum service fluence of 1.46 × 10 to the 19th power n/sq cm (>0.5 MeV) is made possible by establishment of the neutron spectrum at the reactor vessel wall using computer calculations. The maximum fluence derived by this technique compares favorably with another value given by an independently-developed calculated neutron spectrum. The computed service fluence in concert with the embrittlement data projects a maximum transition temperature increase of 265F, which represents a level of embrittlement considered acceptable for the Yankee reactor vessel after thirty fuel cycles of operation at 600 thermal megawatts (Mw (t)). (auth)

35414 (AD–663133) FATIGUE CRACK PROPAGATION AND FRACTURE STUDIES OF A PRESSURE VESSEL STEEL TEMPER EMBRITTLED TO SIMULATE IRRADIATION DAMAGE. Crooker, T. W.; Cooley, L. A.; Lange, E. A. (Naval Research Lab., Washington, D. C.). Oct. 1967. 17p. (NRL-MR-1822). CFSTI.

Fatigue crack propagation tests are conducted using plate bend specimens machined from shell material of the PM-2A half-scale model pressure vessel. The material is a Cr–Mo–V rotor steel, temper embrittled to represent the irradiated shell of the PM-2A reactor vessel. The fatigue tests are conducted in a room-air environment at 80 F, which is 160 F below the NDT (nil-ductility transition) temperature for this steel. Fatigue crack growth rates, are correlated with total strain range, and are found to be similar to fatigue crack growth rates in other structural steels which possess comparable yield strength levels. Fracture occurred in the plate bend specimens of the test material during fatigue cycling. An analysis of the fractures using an approximate solution for the stress-intensity factor, K, give good agreement with previous plane strain fracture toughness measurements on the test material. (auth)

35415 (AECL–2758) URANIUM DIOXIDE FUELS IN ORGANIC-COOLED REACTORS. Hart, R. G.; Oldaker, I. E.; Thexton, H. E.; Walker, J. F. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Dec. 1967. 45p. Dep. CFSTI. CAN $1.50.

The performance requirements and the design parameters for the WR-1 reactor fuel are outlined and the pertinent design calculations are reviewed and results of these calculations are compared with experiment. Calculated pressure drops, sheath temperatures and UO_2 temperatures are in good agreement with experiment, but experimental fission gas releases are higher than those calculated using a simple diffusion model. The experimental work indicates that Zr–2.5% Nb clad UO_2 fuel will have a useful life of at least 1.5 years in the WR-1 reactor. Subsequent operation of the reactor has shown this conclusion to be valid. (auth)

35416 (AECL–3083) CANDU REACTOR AND CANADA'S ECONOMY. Merlin, H. B. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1968. 26p. (CONF-680512–2). Dep. CFSTI. CAN $1.00.

From EIC 82nd Annual General Meeting, Halifax, Nova Scotia.

The estimated capital cost of the Pickering station is $264/kW(e) Comparable coal-fired stations cost $109 to $121/kW(e). By the year 2000, the capital cost difference between coal-fired and CANDU stations may be only $10 to $30/kW(e) in today's dollars. Counteracting resource and manufacturing trends should keep CANDU fuel costs near today's value of $44/kgU to the year 2000. The fuelling portion of unit energy cost will be less than Pickering's 0.68 mill/kWh, however, for new stations with higher net efficiencies. Forecasts of electricity demands and generation of electricity in nuclear stations are presented. By the year 2000 annual demand in Canada is forecast to be 1 trillion kWh, half of which will be supplied by CANDU stations. The low running costs will tend to keep the CANDU stations operating at high capacity factors. Excess energy will be used to replace energy generated in fossil-fired or nuclear stations with higher running costs. Annual and cumulative savings in generating electricity from CANDU units are estimated. By the year 2000 they may amount to over $700 (1968 CAN) million annually or $7 (1968 CAN) billion cumulative. Canada's economy will also benefit by the savings on imports of fossil fuel which would have been required if electricity were not generated in CANDU stations. These savings are estimated at over $1 (1968 CAN) billion annually in the year 2000 and $12 (1968 CAN) billion cumulative. (auth)

35417 (AECL–3085) FISSION GASES, RADIOIODINES AND ACTIVATION PRODUCTS IN THE NPD PRIMARY COOLANT DURING THE FIRST FIVE YEARS OF OPERATION. Allison, G. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1968. 22p. Dep. CFSTI. CAN $1.00.

The major γ-emitting activation products ($t_{1/2} > 1$ h) found in the NPD primary coolant under steady operating conditions are Ar-41, Na-24 and F-18. When the system is disturbed by trips and startups activated corrosion products become major constituents in the γ-ray spectra of the D_2O. Results for the fission gases Kr-88, Xe-135 and Xe-133 and the radioiodines I-135, I-133 and I-131 have indicated that defected UO_2 fuel elements have been present in the reactor during most of its operating time. Highest release rates were measured during the period when a deliberately defected fuel bundle was irradiated at $\int \lambda_\Theta d\Theta \sim 45$ W/cm. At least three defected 19-element bundles which were discharged from the reactor up to March 1967 had undergone mechanical damage. These bundles could not have exceeded a maximum $\int \lambda_\Theta d\Theta$ of ~20 W/cm. Measured release rates have been compared with those calculated using a release model developed from tests of defected fuel in a loop in the NRX reactor. (auth)

35418 (AECL–3089) CANADIAN EXPERIENCE WITH WIRE WRAPPED FUEL FOR POWER REACTORS. Domaratzki, Z. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1968. 25p. (CONF-680512–1). Dep. CFSTI. CAN $1.00.

From EIC 82nd Annual General Meeting, Halifax, Nova Scotia.

The fuel elements for the NPD and Douglas Point reactors consist of UO_2 pellets loaded in a thin walled Zircaloy-Z tube. Elements are spirally wrapped with 0.048 inch diameter Zircaloy-2 wire to space them from adjacent elements in the pressure tube and to improve coolant mixing between sub-channels. The wire and Zircaloy-2 end caps are resistance welded to the fuel sheath. The fabrication development, laboratory tests, and irradiation tests performed in evaluating the fuel element design are outlined. (H.D.R.)

35419 (AECL–3126) FUEL CHANNEL DEVELOPMENT FOR CANADA'S POWER REACTORS. Ross-Ross, P. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1968. 31p. (CONF-680512–3). Dep. CFSTI. CAN $1.00.

From EIC 82nd Annual General Meeting, Halifax, Nova Scotia.

The fuel channels and their general arrangement in the CANDU–PHW and CANDU–BLW reactors are described. Aspects of the development work related to strength and ductility of irradiated material, the creep behavior of tubes, corrosion considerations, the joining of the zirconium alloy tubes to stainless steel parts, inspection of tubes for damage due to operation, and to critical crack length phenomena are described. (auth)

35420 (AEEW-R–571) PARAMETER ESTIMATION FROM DRAGON HIGH TEMPERATURE GAS COOLED REACTOR DYNAMIC EXPERIMENTS. Cummins, J. D. (Atomic Energy Establishment, Winfrith (England)). Oct. 1967. 107p. (DP-Report–598). Dep. CFSTI. UK 14s. 0d.

Dynamic experiments were performed on the Dragon high temperature gas cooled reactor at full power of 20 MW(t). Both terminated ramp and pseudo-random chain code perturbations were applied to a control rod for two amplitudes of reactivity perturbation. Neutron flux and thermocouple signals were observed and recorded, together with samples of the inherent noise with the reactor unperturbed. Frequency responses were deduced from the measurements and compared with previous sinusoidal frequency response measurements and theoretical predictions. A simplified model was constructed and optimized by least squares fitting of the equivalent response from the binary cross correlator to the model's output. These optimizations showed that a very simple feedback model is appropriate to Dragon and that a good estimate of the power/reactivity coefficient and temperature coefficient of reactivity may be made. (auth)

35421 (AI-AEC-Memo-12574) PNPF RECOVERY CORE LOWER GRID PLATE TEMPERATURES. Moore, H. (Atomics International, Canoga Park, Calif.). Jan. 16, 1968. 22p. Dep. CFSTI.

Alternate configurations of element lower end fittings are considered in the determination of clearances and leakage flows through holes in the lower grid plate. Gamma heating rates in the lower grid plate for a 41-element core operating at 30 Mw are calculated. Heat transfer coefficients are derived. Axial temperature profiles at an adiabatic locus in the hottest region of the plate are determined for each configuration. For an end fitting of 4.358 in. diameter two limiting cases are considered. With zero clearance (a plugged hole) the maximum differential temperature is found to be 51°F, producing a deflection of the lower grid plate conservatively calculated not to exceed 25 mils and no outlet thermocouple error due to mixing. With a diametral clearance of 0.020 in., resulting from maximum tolerances, the temperature gradient is found to be 15°F, producing a plate deflection of approximately 7 mils and an outlet thermocouple error due to coolant mixing of about 1°F at 100% element flow. It is concluded that this configuration is acceptable from thermal and hydraulic considerations and that no thermocouple shroud will be required to reduce mixing errors. (auth)

35422 (ANL-7445) REACTOR DEVELOPMENT PROGRAM. Progress Report, April 1968. (Argonne National Lab., Ill.). June 12, 1968. Contract W-31-109-eng-38. 155p. Dep. CFSTI.

This monthly progress report includes information on ERR-II, ZPR-3, ZPPR, LMFBR, general reactor technology, and reactor safety. For detailed information, see the annual reports from the following ANL Divisions: Chemical Engineering, Metallurgy, Reactor Engineering, and Reactor Physics. 13 references. (J.M.J.)

35423 (APDA-224) QUARTERLY TECHNICAL PROGRESS REPORT ON AEC-SPONSORED ACTIVITIES, JANUARY-MARCH 1968. (Atomic Power Development Associates, Inc., Detroit, Mich.). Contract AT(11-1)-865. 87p. Dep. CFSTI.

STAINLESS STEEL—wastage from water leaks in type 304 tubes of, effects of liquid sodium on, (E); tube erosion of type 321, effects of liquid sodium on, (E)
CROLOY—water leaks in tubes of, effects of liquid sodium on, (E); tube erosion, effects of liquid sodium on, (E); tube corrosion of, effects of sodium hydroxide at 1300 to 2200°F on, (E)
SODIUM—corrosive effects on type 304 stainless steel and Croloy tubes of liquid, effects of water leaks on, (E); erosive effects on tubes of type 321 stainless steel, Croloy, and Incoloy 800 by liquid, (E)
TUBES—corrosion of type 304 stainless steel and Croloy, effects of water leaks on liquid sodium, (E); erosion of type 321 stainless steel, Croloy, and Incoloy 800, effects of liquid sodium on, (E)
INCOLOY 800—tube erosion, effects of liquid sodium on, (E)
SODIUM HYDROXIDES—corrosion of Croloy tubes by, effects at 1300 to 2200°F of, (E)
GAGES AND METERS—performance of oxygen, effects of liquid sodium oxide (Na_2O) on, (E)
RHOMETERS—performance of, effects of liquid sodium oxide (Na_2O) on, (E)
ULTRASONIC INSPECTION—use of narrow-beam transducers for scanning systems in liquid sodium at 600°F, description of
CRITICAL ASSEMBLIES—physics measurements for plutonium-fueled ZPR-3 Assembly 48, analysis of one-dimensional 24-group spherical-geometry; physics measurements for uranium-fueled ZPR-6 Assembly 2, analysis of one-dimensional 24-group spherical-geometry
SODIUM OXIDES—effects on performance of oxygen meters and Rhometers, analysis of, (E) (D.C.C.)

35424 (BMI-1841) COMPARISON OF BWR CORE HEATUP CALCULATIONS. Wooton, R. O. (ed.) (Battelle Memorial Inst., Columbus, Ohio). May 31, 1968. Contract W-7405-eng-92. 22p. Dep. CFSTI.

Four computer codes for describing core heatup and the extent of metal-water reactions in a water-cooled reactor following a postulated loss-of-coolant accident in which emergency core-cooling systems are assumed to fail were compared and the differences between them assessed. The codes are CHEMLOC, written by ANL; NURLOC, by BCL; TACT, by GE; and ARC by PPCo. A common problem was defined for the codes; namely, a postulated accident in the Browns Ferry Reactor. Four calculated sets of results were compared: blowdown heat transfer, axial temperature distribution, core-temperature volume-percentile relationships, and metal-water reaction. The results agree quite well. No differences were traced to program errors. Some differences seemed to result from assumptions about basic input parameters; that is, the problem was not completely the same for all participants. Differences in metal-water reaction models can affect results significantly above core temperatures of 2500°F. The codes seem sophisticated enough for their purposes, and no further theoretical development seems called for. (auth)

35425 (BMI-1900) COMPENDIUM OF PROPERTIES AND CHARACTERISTICS FOR SELECTED LMFBR CLADDING MATERIALS. Conner, Jack G.; Porembka, Stanley W. (eds.) (Battelle Memorial Inst., Columbus, Ohio). May 15, 1968. Contract W-7405-eng-92. 234p. Dep. CFSTI.

Data are compiled for cladding materials that appear to be the most attractive for LMFBR application as of 1967. The properties of both unirradiated and irradiated materials are included and, in the latter category, mixed thermal and fast flux irradiation data are presented along with the less available fast flux data. Joining techniques are reviewed for the various cladding materials as the techniques pertain to fuel-element fabrication. Both the austenitic stainless steels and the nickel-base alloys, Hastelloy X and Inconel 625, exhibit an elevated-temperature irradiation embrittlement, although data for the nickel-base alloys are limited. Niobium-1 wt % zirconium and the binary and ternary vanadium-base alloys provide good strength and ductility at elevated temperatures, and irradiation damage appears minimal. The stainless steels and the nickel-base alloys exhibit good sodium corrosion resistance up to 600 and 650°C, respectively; above these temperatures mass-transfer problems occur, especially with the nickel-base alloys. In general, vanadium alloys show sodium corrosion resistance at 650°C superior to that of niobium alloys, although both systems present problems in contaminated sodium. Good compatibility with oxide and nitride fuels is generally indicated for the stainless steels and the nickel-base alloys, but compatibility with metallic and carbide fuels presents certain problems. Limited data for the vanadium alloys show encouraging compatibility results with most potential LMFBR fuels. (auth)

35426 (BNWL-676) THEORY OF CORROSION PRODUCT GENERATION, DISPERSION, AND ACTIVATION PROCESSES. Bartlett, J. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 100p. Dep. CFSTI.

A theoretical discussion of transport phenomena for corrosion products in water cooled nuclear reactors is presented. Processes and mechanisms of corrosion product transport are defined, and a system of equations to describe corrosion product mass and activity dispersion is developed. Theoretical and experimental work required to advance understanding is described. (auth)

35427 (CVNA-287) CVTR FUEL MANAGEMENT. Nath, R. J.; Alligood, F. M. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug. 1967. Contract AT(30-1)-2289. 228p. Dep. CFSTI.

Based upon the performance of the core, it is apparent that the analytical methods and models developed for use throughout the fuel management program were quite adequate. The good agreement demonstrated that the analytical techniques applied to this core are applicable to the larger heavy water cooled and moderated pressure tube power reactors. The calculated lifetimes of the two refueling operations were in excellent agreement with plant performance. In addition, the predicted power distributions as a function of both core depletion and control rod withdrawal were in good agreement with the measured values. In conjunction with the fuel management program, four special high power density test assemblies were inserted into the core. Operation of these assemblies provided additional knowledge of the performance of high power density fuel. During the tests, these assemblies developed leaks which led to their ultimate withdrawal significantly prior to their planned burnup exposure. Subsequent to the removal of all the test assemblies the decision was made to terminate CVTR operation. (auth)

35428 (CVNA-289) EXAMINATION OF CVTR COMPONENTS. Smalley, W. R.; Paxson, E.; Hornak, L. P.; Jones, M. B. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). June 1967. 76p. Dep. CFSTI.

As part of a program to evaluate the irradiation performance of CVTR components, one of the highest exposure Zircaloy pressure tubes from Core I was sectioned and subject to non-destructive and destructive examinations. In addition, several of the black control rods were measured after Core I service to determine the extent of irradiation-induced bow. Optical microscopy revealed no changes in basic microstructure as a result of irradiation. The mechanical property changes were evaluated by microhardness measurements, ring flattening tests and hot burst tests. This examination confirms the excellent performance of Zircaloy-4 as a pressure tube material in the CVTR. A control rod bow measuring device, utilizing linear variable differential transformers, was shown to be capable of making reliable measurements to ±0.01 inch. The measurements indicated that some control rod bow had occurred—up to 0.93 in.—but did not cause any operational problems in CVTR. (auth)

35429 (DOCKET-50155-1) [BIG ROCK POINT REACTOR]. Technical Specification, Change No. 13. (Consumers Power Co., Jackson, Mich.). Nov. 10, 1967. 54p. Dep. CFSTI.

A summary of experiments and calculations on fuel failure threshold for the Big Rock Point Power Reactor is given; SPERT and TREAT data are tabulated. An analysis of a reactivity insertion accident resulting from control rod failure is detailed; data are presented graphically. Effects of high performance fuel pins and bundles on the severity of an excursion are analysed. Reactivity transients and their effects are evaluated. Maximum fuel pin temperature is given as a function of pipe break size. The criterion for maximum permissible central melting is discussed; the calculational model for thermal analyses is described. The proposed inspection program for the experimental fuel is detailed. An evaluation of loss of external load is given. (M.L.S.)

35430 (DOCKET-50219-14) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Status Report on Reactor Vessel Repair Program, Amendment 29. (Jersey Central Power and Light Co., Morristown, N. J.). Dec. 4, 1967. 57p. Dep. CFSTI.

A status report on the repair program for the Oyster Creek Power Reactor, Unit 1, reactor vessel is given. Examination of the stub tube weld defects is described; results of metallographic analyses are shown. Preliminary results of chemical cleaning operations are tabulated; control rod drive-penetrations repair procedures are given. (M.L.S.)

35431 (DOCKET-50231-17) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. [Facility Description and Safety Analysis Report], Amendment 15. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). May 17, 1968. 6p. Dep. CFSTI.

Procedures and safety considerations for fuel element handling at the Southwest Experimental Fast Oxide Reactor are given. The number of fuel elements will be limited to six standard or depleted elements for the purpose of testing the compatibility of the as-built fuel elements. (M.L.S.)

35432 (DOCKET-50231-18) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Amendment 16, Suppl. 17. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). May 27, 1968. 290p. Dep. CFSTI.

Information on the Southwest Experimental Fast Oxide Reactor is presented under the following broad topics: Facility Design; Inner Containment; Outer Containment; Containment—General; Physics; Reactor Vessel; Instrumentation; Reflector Control System; Reactor Vessel Internals; General Plant Design; Refueling Cell; Safety Analyses; and Environs and Radiological Effects. (M.L.S.)

35433 (DOCKET-50259-1) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. Design and Analysis Report, Vol. 1. (Tennessee Valley Authority, [Knoxville]). July 7, 1966. 358p. (DOCKET-50260-1; NP-16251(Vol.1)). Dep. CFSTI.

Information on Browns Ferry Power Reactor, Units 1 and 2, is given under the following broad headings: Introduction and Summary; Site and Environment; Reactor Design; Reactor Cooling System; Containment Systems including primary and secondary containment and structural and shielding design; Additional Engineered Safeguards; Radioactive Waste Control Systems; Plant Electrical Systems; Plant Control and Instrumentation; Auxiliary and Emergency Systems; Steam and Power Conversion System; other Plant Structures; Conduct of Operations; and Safety Analyses including incidents, design basis accidents, analytical methods, and excursion description. (M.L.S.)

35434 (DOCKET-50259-2) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. Design and Analysis Report, Vol. 2. (Tennessee Valley Authority, [Knoxville]). July 7, 1966. 296p. (DOCKET-50260-2; NP-16251(Vol.2)). Dep. CFSTI.

All engineering design drawings for Browns Ferry Power Reactor, Units 1 and 2, are included. Included, also, are: Reliability Analysis of Reactor Protection Systems; Control Rod Drive System Description and Analysis; Jet Pump Development; and Core Spray Test Program. (M.L.S.)

35435 (DOCKET-50259-3) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. Design and Analysis Report, Amendment 2. (Tennessee Valley Authority, [Knoxville]). Nov. 2, 1966. 219p. (DOCKET-50260-3; NP-16251(Amend.2)). Dep. CFSTI.

Revised information on Browns Ferry Power Reactor, Units 1 and 2, is presented on the following subjects: introduction and summary; reactor core design; reactor cooling systems; containment systems; additional engineered safeguards including control rod velocity limiter, standby liquid control system, core spray cooling systems, residual heat removal (RHR) system, containment inverting system, high pressure coolant injection system (HPCIS), and standby coolant supply system; radioactive waste control systems; plant electrical systems; plant control and instrumentation; reactor auxiliary services and systems; steam and power conversion systems; and safety analyses. Revisions to material contained in original PSAR Appendices and revised drawings are also included. (M.L.S.)

35436 (DOCKET-50259-4) BROWNS FERRY NUCLEAR POWER PLANT, [UNITS 1 AND 2]. [Design and Analysis Report], Amendment 3. (Tennessee Valley Authority, [Knoxville]). Nov. 10, 1966. 211p. (DOCKET-50260-4; NP-16251(Amend.3)). Dep. CFSTI.

Information on Browns Ferry Power Reactor, Units 1 and 2, is given under the following broad topics: Site; General—which includes design criteria, pressure vessel design reactor internals and cooling system designs, missile protection, operator training, earthquake design of piping, containment design and quality control, and control room shielding and ventilation; Secondary Containment Building; Reactor Vessel and Internals; Instrumentation and Reactor Protection System; Radioactive Waste System; Safety Evaluation—including steam line rupture and isolation, recovery from loss-of-coolant, loss of pump power, loss of coolant-no core cooling, fuel cladding stresses, basis for overpower scram, reactivity accidents, rod drop-range of initial conditions, and effect of Pu on excursions; Plant and System Performance; and Station Stability. (M.L.S.)

35437 (DOCKET-50259-5) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. [Design and Analysis Report], Amendment 4. (Tennessee Valley Authority, [Knoxville]). Nov. 18, 1966. 12p. (DOCKET-50260-5; NP-16251(Amend.4)). Dep. CFSTI.

Effects of reactor overpower on fuel rods in Browns Ferry Power Reactor, Units 1 and 2 are shown graphically Methods for calculation of power distributions are discussed. Bases for thermal design characteristics are outlined. (M.L.S.)

35438 (DOCKET-50259-6) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. Design and Analysis Report, Amendment 5. (Tennessee Valley Authority, [Knoxville]). Nov. 25, 1966. 38p. (DOCKET-50260-6; NP-16251(Amend.5)). Dep. CFSTI.

Revised information is given on the site, containment systems and safety evaluations for the Browns Ferry Power Reactor, Units 1 and 2. (M.L.S.)

35439 (DOCKET-50259-7) BROWNS FERRY NUCLEAR POWER PLANT, [UNITS 1 AND 2]. [Design and Analysis Report], Amendment 6. (Tennessee Valley Authority, [Knoxville]). Dec. 16, 1966. 184p. (DOCKET-50260-7; NP-16251(Amend.6)). Dep. CFSTI.

Information on Browns Ferry Power Reactor, Units 1 and 2, is given under the following broad headings: General—including instrumentation and procedures related to control rod positioning, refueling procedures, fuel element orientation, fuel rod damage limit, cladding stresses, fuel assembly flow blockage, critical heat flux (CHF) data points, mixing within fuel assembly, and blowdown model; Accident Analysis; and Core Cooling Systems—including description, diesel generator sizing, applicability of core spray tests, control room missile protection, and pressure and temperature associated with 27.5% metal-water reaction. (M.L.S.)

35440 (DOCKET-50259-8) BROWNS FERRY NUCLEAR POWER STATION, [UNITS 1 AND 2]. [Design and Analysis Report], Amendment 7. (Tennessee Valley Authority, [Knoxville]). Feb. 2, 1967. 35p. (DOCKET-50260-8; NP-16251(Amend.7)). Dep. CFSTI.

Information on Browns Ferry Power Reactor, Units 1 and 2, is given under the following topics: core cooling margins for Browns

Ferry fuel ratings; containment capability; fuel element failure modes under loss-of-coolant conditions; fuel temperature rise during depressurization from High Pressure Coolant Injection (HPCI) to Low Pressure Coolant Injection (LPCI); and blowdown calculations-bases and assumptions. Revised data (as of 2/2/67) are also included. (M.L.S.)

35441 (DOCKET-50259-9) [BROWNS FERRY NUCLEAR POWER STATION, UNITS 1 AND 2]. [Design and Analysis Report], Amendment 1. (Tennessee Valley Authority, [Knoxville]). Oct. 21, 1966. 112p. (DOCKET-50260-9; NP-16251(App.G and H)). Dep. CFSTI.

The core thermal design for Browns Ferry Power Reactor, Units 1 and 2, is detailed; complete heat transfer analyses are given; data are shown graphically. The design of the Browns Ferry units is evaluated with respect to the General Design Criteria. (M.L.S.)

35442 (DOCKET-50289-6) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 1. (Metropolitan Edison Co., Reading, Pa.). July 21, 1967. 181p. Dep. CFSTI.

Revised information on Three Mile Island Power Plant, Unit 1, is given on the following broad headings: Site and Environment which reflects flood flow studies; Reactor, denoting the incorporation of rack and pinion control rod drive mechanisms; Reactor Coolant System; Containment, reflecting a change in the number of reactor building atmosphere cooling units; Engineered Safeguards; Auxiliary and Emergency Systems which shows changes in the number of make-up pumps and the incorporation of cooling towers to replace the cooling pond in the condenser circulating system; and Safety Analyses. (M.L.S.)

35443 (DOCKET-50289-7) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 2. (Metropolitan Edison Co., Reading, Pa.). Oct. 2, 1967. 94p. Dep. CFSTI.

Additional information on Three Mile Island Power Reactor, Unit 1, is given under the following: Introduction and Summary; Reactor; Reactor Coolant System; Instrumentation and Control; Electrical Systems; Auxiliary and Emergency Systems; Steam and Power Conversion System; and Radioactive Waste and Radiation Protection. Appendices include: Structural Design Bases; Design Program for Reactor Building; Design Criteria for Reactor Building; and Quality Control. (M.L.S.)

35444 (DOCKET-50289-8) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 3. (Metropolitan Edison Co., Reading, Pa.). Nov. 6, 1967. 120p. Dep. CFSTI.

Design parameters for Three Mile Island Power Reactor, Unit 1, are tabulated; these are compared with Oconee Power Reactor, Units 1 and 2, Turkey Point Power Reactor, Units 3 and 4, and Indian Point Power Reactor, Unit 2. Reactor cooling systems tests and inspections are listed; leakage of engineered safeguards is considered. Revised reactor control information is given. Analyses of effects and consequences of reactor incidents are evaluated. A blowdown analysis for various pipe break sizes is given. Use of ungrouted tendons for post-tensioning the concrete structures is detailed; in-service surveillance is described. A complete analysis of thermal shock to primary system components, induced by Emergency Core Cooling System (ECCS) operation, is given. The report: "The Properties and Microstructure of Spray-Quenched Thick-Section Steels" is included. (M.L.S.)

35445 (DOCKET-50289-9) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Vol. 4. (Metropolitan Edison Co., Reading, Pa.). Oct. 2, 1967. 226p. Dep. CFSTI.

A comparison of the design of Three Mile Island Power Reactor, Unit 1, with the General Design Criteria is given. Foundation soil characteristics are tabulated. Cooling water supply and effects of accidental dumping of stored waste are evaluated. Revised reactivity calculations and analyses are detailed. Research, development, and test programs for core components are discussed. Methods for prevention of vapor lock in the hot leg of the cooling system are evaluated. Stability of the thiosulfate safety injection system and its effects on reactor internals is considered. Loss-of-coolant accidents are analysed as a function of pipe break sizes. Design and loading factors for containment structures are detailed. Containment shell analyses, missile protection, and penetrations are discussed. Liner design and loadings are outlined; prestressing tendons and reinforcing materials are described. Construction and surveillance procedures are listed. A single failure analysis for the power supply to the engineered safety system is given. Schematics and tabulations of the radiation monitoring system are presented. (M.L.S.)

35446 (DOCKET-50302-1) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 1. (Florida Power Corp., St. Petersburg). Aug. 10, 1967. 200p. (DOCKET-50303-1). Dep. CFSTI.

Information on Crystal River Power Reactor, Units 3 and 4, is given under the following broad topics: Introduction and Summary; Site and Environment; Reactor; and Reactor Coolant System. (M.L.S.)

35447 (DOCKET-50302-2) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 2. (Florida Power Corp., St. Petersburg). Aug. 10, 1967. 150p. (DOCKET-50303-2). Dep. CFSTI.

Information on Crystal River Power Reactor, Units 3 and 4, is given under the following broad topics: Containment System; Engineered Safeguards; Instrumentation and Control Systems; Electrical Systems; Auxiliary and Emergency Systems; and Steam and Power Conversion System. (M.L.S.)

35448 (DOCKET-50302-3) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 3. (Florida Power Corp., St. Petersburg). Aug. 10, 1967. 137p. (DOCKET-50303-3). Dep. CFSTI.

Information on Crystal River Power Reactor, Units 3 and 4, is given on the following broad topics: Radioactive Wastes and Radiation Protection; Conduct of Operations; Initial Tests and Operation; Safety Analysis; and Technical Specifications. (M.L.S.)

35449 (DOCKET-50302-4) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Preliminary Safety Analysis Report, Vol. 4. (Florida Power Corp., St. Petersburg). Aug. 10, 1967. 16p. (DOCKET-50303-4). Dep. CFSTI.

Additional information on Crystal River Power Reactor, Units 3 and 4, is given on the following: DNB ratios at design overpower, use of spray coolants during loss-of-coolant accidents, and reactor building seismic design. (M.L.S.)

35450 (DOCKET-50302-5) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 1. (Florida Power Corp., St. Petersburg). Jan. 15, 1968. 218p. (DOCKET-50303-5). Dep. CFSTI.

Revised information on Crystal River Power Reactor, Units 3 and 4, is given on the following topics: Site and Environment; Reactor; Reactor Coolant System; Containment System; Engineered Safeguards; Instrumentation and Control; Electrical Systems; Auxiliary and Emergency Systems; Steam and Power Conversion Systems; Radioactive Wastes and Radiation Protection; and Safety Analyses. These revisions reflect engineering modifications in plant systems. Engineering geology studies are detailed; test boring data are given. Structural design bases are defined; the design program and design criteria for the reactor building are described. Overall quality control procedures are given. (M.L.S.)

35451 (DOCKET-50302-6) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. APPENDICES. Preliminary Safety Analysis Report, Amendment 2, [Pt. 1]. (Florida Power Corp., St. Petersburg). Feb. 7, 1968. 110p. (DOCKET-50303-6). Dep. CFSTI.

Revised information on the emergency injection system for the Crystal River Power Reactor, Units 3 and 4, is given. The design bases are discussed; a single failure analysis is detailed; a line diagram is shown. Electrical system design is described; a single line diagram is given. Makeup and purification system equipment data are tabulated. Decay heat removal design parameters and performance data are listed. Diagrams of the makeup and purification system and the cooling water systems are shown. (M.L.S.)

35452 (DOCKET-50302-7) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. APPENDICES. Preliminary Safety Analysis Report, Amendment 2, [Pt. 2]. (Florida Power Corp., St. Petersburg). Feb. 7, 1968. 326p. (DOCKET-50303-7). Dep. CFSTI.

Technical qualifications of key personnel and prime contractors for the Crystal River Power Reactor, Units 3 and 4, are given. Population and land use around the Crystal River site are detailed. Site meteorological data are tabulated; flood studies and hurricane effects are described. Site engineering geology studies are detailed; test boring data are tabulated. Detailed seismological analyses are presented; earthquake response spectra are shown. Structural design bases are given. The design program and design criteria for the reactor building are described. Quality control procedures and containment vessel liner plate specifications are given. Effects of turbine generator produced missiles are analyzed. Florida state public safety procedures are included. (M.L.S.)

35453 (DOCKET-50302-8) [CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4]. [Preliminary Safety Analysis Report], Suppl. 1. (Florida Power Corp., St. Petersburg). Feb. 7, 1968. 97p. (DOCKET-50303-8). Dep. CFSTI.

Additional information on Crystal River Power Reactor, Units 3 and 4, is given concerning the following: reactor and coolant system, containment, emergency core cooling systems, instrumentation and control, radioactive wastes, emergency plans, preoperational testing, coolant flow analysis with one failed pump, seismic load combinations for piping and reactor vessel and internals, method for determining maximum allowable stresses, and dynamic analyses of piping systems. (M.L.S.)

35454 (DOCKET-50309-11) [MAINE YANKEE ATOMIC POWER STATION]. THERMAL SHOCK ANALYSIS ON REACTOR VESSELS DUE TO EMERGENCY CORE COOLING SYSTEM OPERATION. Tuppeny, W. H. Jr.; Siddall, W. F.; Hsu, L. C. (Combustion Engineering, Inc., Windsor, Conn.). Mar. 15, 1968. 75p. Dep. CFSTI.

For Maine Yankee Atomic Power Co., Wiscasset.

Effects of Emergency Core Cooling System (ECCS) operation on the reactor vessel for the Maine Yankee Power Reactor are analysed. Reactor vessel heat transfer, stress, and failure analyses are detailed. Both the fracture mechanics and nil ductility methods are used for determining brittle fracture. Mechanical, seismic, residual, and transient thermal stresses are considered. 30 references. (M.L.S.)

35455 (DPSPU-66-30-13) CONTROLLING TRITIUM HAZARDS AROUND HEAVY WATER MODERATED REACTORS. Cooley, R. C. Sr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). May 1968. Contract AT(07-2)-1. 15p. (CONF-680607-1). Dep. CFSTI.

From 13th Annual Health Physics Society Meeting, Denver, Colo.

In heavy water moderated reactors tritium (T) is formed as neutrons are absorbed by the heavy water (D_2O). Hazards from T released to personnel zones during repair and maintenance operations are minimized by proper job evaluation and selection of correct protective equipment. At Savannah River Plant basic information has been developed to facilitate this process. Curves included show: buildup of T in moderator as a function of reactor operating time and neutron flux, response of Kanne chambers to airborne concentrations of T, concentration of T in air as a function of T concentration in spilled moderator, T concentration in air above large basins of water as a function of T concentration in the water, rate of assimilation of T by personnel with and without respiratory protection as a function of T concentration in air, assimilation resulting from contact of various parts of the body with the moderator as a function of T concentration in the moderator, and dose received from assimilated T as a function of T concentration in urine and biological half-life. (auth)

35456 (EURAEC-1965) STABILITY TESTS ON BOILING WATER REACTORS. 8th Quarterly Report, October 1-December 31, 1967. Schoeneberg (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). Contract 085-66-1-TEED. 18p. (EUR-3774). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

In order to investigate the influence of parallel reactor channels on the transfer function "heat flux-local void fraction" a first, preliminary measurement of this frequency response was done with and without constant pressure drop over the test section. The pressure drop was held constant with a control system changing mass flow in the test section. The measured transfer functions "mass flow-local void fraction" were recalculated using modified input parameters in the computer program AMOK-L. This resulted in a better agreement between theory and experiment at high frequencies. (auth)

35457 (GEAP-5100-6) HIGH PERFORMANCE UO_2 PROGRAM. THE THERMAL CONDUCTIVITY OF UO_2 BY DIRECT IN-REACTOR MEASUREMENT. Coplin, D. H.; Hausner, H.; Lyons, M. F.; Weidenbaum, B. (General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.). Mar. 1968. Contract AT(04-3)-189. 46p. (EURAEC-2032). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Direct in-reactor measurements were made of the thermal conductivity of sintered pellet and vibratory compacted UO_2 fuel to temperatures as high as 2750°C. The basic measurement technique was the use of a gas bulb thermometer to sense the UO_2 central temperature in an irradiation capsule with simultaneous measurement of the capsule heat generation by calorimetry. The experimental thermal conductivity measurements for pellet UO_2 fuel are in substantial agreement with previously reported data based on indirect methods. However, development of the temperature sensor device was conducted concurrently with the capsule irradiations to measure thermal conductivity. A critical review of all the experimental data since completing the irradiations have revealed an inconsistency in the out-of-pile calibration results that detracts from the reliability of the sensor calibration technique. Consequently, the confidence in the absolute accuracy of the in-pile measurements is also reduced. Nevertheless, the capability of gas bulb thermometry to indicate extreme temperatures in-pile, heretofore unobtainable, was successfully demonstrated. Coupled with the inherent potential of the device for extended operation under irradiation, the gas bulb thermometer appears worthy of further intensive development. (auth)

35458 (GEAP-5465) SEFOR CORE CLAMPING MODEL TESTS ONE-SIXTH SEGMENT. Cochran, J. T. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Mar. 1968. Contract AT(04-3)-540. 62p. Dep. CFSTI.

Results of experiments with the core channel clamping mechanism proposed for SEFOR are presented. A series of tests were performed with a full-size model of a 60 degree sector of the core channels. The mockup included 22 full-size hexagonal channels supported by a core plate and restrained in the radial direction by torsion bar clamping devices. The tests were conducted to determine channel movement during clamping, final clamped channel position, channel deflection, and the effect of thermal gradients. (H.D.R.)

35459 (GEAP-5587) REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY. Quarterly Progress Report No. 11, October-December 1967. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar. 1968. Contract AT(04-3)-189. 137p. Dep. CFSTI.

HEAT TRANSFER SYSTEMS—failures in pipes of reactor, probability analysis for mechanisms of, (E/T)
PIPES—failures in reactor cooling system, probability analysis for mechanisms of; failures in carbon steel, low alloy steel, and stainless steel, analysis of crack, (E/T)
REACTORS—cooling systems, analysis of failures in pipes of, (E/T)
STAINLESS STEEL—pipes of, analysis of crack failures in, (E/T); pipes of type 304, effects of 550°F on failure stress measurements in, (E)
CARBON STEEL—pipes of, analysis of crack failures in, (E/T); pipes of, effects of 550°F on failure stress measurements in, (E)
STEEL—pipes of low alloy, analysis of crack failures in, (E/T)
MATERIALS TESTING, DESTRUCTIVE—pipe failures during thermal cycling, analysis of carbon steel, low alloy steel, and stainless steel, (E)
STRESS—measurement of carbon steel, low alloy steel, and stainless steel pipe failures, description of computer program for, (E/T)
CHROMIUM ALLOYS AND SYSTEMS—Cr-Mo, failures in pipes of, analysis of crack, (E); Cr-Mo, pipes of, effects of 550°F on failure stress measurements in, (E)
CRACKS—measurement of carbon steel, low alloy steel, and stainless steel pipe, description of computer program for, (E/T)
COMPUTER PROGRAMS—PLOT 4, for crack growth rate calculations from experimental circumferential crack growth measurements (D.C.C.)

35460 (GEAP-5605) POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM. Progress Report No. 6, January 1-March 31, 1968. Ogawa, S. Y. (comp.) (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Apr. 1968. Contract AT(04-3)-189. 15p. (EURAEC-2033). Dep. CFSTI.

The irradiation of the six centermelt fuel assemblies was started on March 15, in the Consumer Power Company's Big Rock Point Reactor. The first 12 days of operation was at a relatively low power (53% of plant rated). On March 28, the reactor power level was raised to about 73% of plant rating. At this level, the advanced performance (0.700-inch-diameter rods) compacted powder fuel is operating with central melting to about 8% of the cross-sectional area. The reactor power level that must be attained for this cycle in order for central melting to occur in all the centermelt bundles has been calculated to be 87% of the reactor rated power. One of the two recirculation pumps malfunctioned on start-up, and therefore, the reactor is being operated with one pump. Further increases in reactor power beyond the present 175 MWt will not be made until the inoperative pump is repaired. Repair parts are expected to arrive during the first week in April. (auth)

35461 (GEMP-482) RECOMMENDED PROPERTY AND REACTION KINETICS DATA FOR USE IN EVALUATING A LIGHT-WATER-COOLED REACTOR LOSS-OF-COOLANT INCIDENT INVOLVING ZIRCALOY-4- OR 304-SS-CLAD UO_2. Brassfield, H. C.; White, J. F.; Sjodahl, L.; Bittel, J. T. (General Electric

Co., Cincinnati, Ohio. Missile and Space Div.). Apr. 1968. Contract AT(40-1)-2847. 89p. Dep. CFSTI.

Selected values are presented for the high temperature physical and mechanical properties of fuel element materials involved in a loss-of-coolant incident in a boiling water or pressurized water nuclear reactor. The fuel element materials considered are Zircaloy-2 and -4, 304 SS, and UO_2. Where possible, the property values have been critically evaluated taking into consideration the meltdown environment of steam or steam and air. The physical properties discussed are: melting point, boiling point, heat of fusion, heat of vaporization, vapor pressure, phase transformations, coefficient of thermal expansion, density, total normal emittance, thermal conductivity and enthalpy and heat capacity. The mechanical properties discussed are: tensile strength, ductility, compressive strength, and modulus of elasticity. In most instances, values of various properties are given as a function of temperature to the melting point of the material. The kinetics of the oxidation reactions of the cladding materials with steam are also discussed and equations presented for calculation of oxidation rates under isothermal conditions for one atmosphere of steam. (auth)

35462 (HPR-89) THE FUEL DYNAMICS OF A THIN-WALLED METALLIC URANIUM TUBULAR ASSEMBLY. Toepfner, F. I. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Dec. 1967. 51p. Dep.

The fuel dynamics of a thin-walled metallic uranium tubular assembly are studied experimentally and theoretically. Transfer functions from power to heat flux and power to average fuel temperature are determined. The power is perturbed by varying sinusoidally the reactivity by a reactivity oscillator placed in the center of the core. The heat flux responses can be measured up to a frequency of 1.2 Hz by means of fast thermocouples attached to the canning of the fuel. The responses of the average fuel temperature are determined up to a frequency of 2.0 Hz by means of a fuel elongation detector. The accuracy, in terms of standard deviation, is 1 db for the gain and 5 degrees for the phase. The effect of changes in power level, subcooling and pressure is measured. The main fuel time constant is found to be approximately 1 second both by theory and by experiment. The agreement between the measured and the predicted transfer functions from power to heat flux and from power to average fuel temperature is reasonably good within the frequency range covered by the experiments. The computed average steady state temperatures versus channel power are approximately 5% lower than the measured ones. (auth)

35463 (HPR-95) DESCRIPTION OF THE HBWR PLANT. Jamne, E.; Siverts, J. G. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Dec. 1967. 214p. Dep.

Topics described include: reactor vessel; reactor core; fuel elements; heavy water circuits; main light water circuits; control stations; shielding; containment; reactor safety; waste disposal; and control and instrumentation. (D.C.C.)

35464 (HPR-99) HBWR QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1968. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). May 1968. 117p. Dep.

HALDEN BOILING REACTOR—operations during January to March 1968, description of; fuel assemblies for, description of; turbine design for, effects of fluid flow on optimum
REACTOR FUEL ELEMENTS—failures of Halden Boiling Reactor, analysis during January to March 1968 of; fabrication of Halden Boiling Reactor plutonium oxide (PuO_2)–uranium oxide (UO_2) and uranium oxide (UO_2), description of; heat transfer in Halden Boiling Reactor, measurement of
IODINE-131—diffusion in Halden Boiling Reactor of fission product, analysis of
XENON-133—diffusion in Halden Boiling Reactor of fission product, analysis of
CRITICALITY STUDIES—startup of Halden Boiling Reactor, effects of xenon reactivity on
XENON—reactivity effects on Halden Boiling Reactor, analysis of startup
HEAT TRANSFER SYSTEMS—control system for Halden Boiling Reactor, description of digital computer
URANIUM OXIDE UO_2—fuel elements of, analysis of burnup of Halden Boiling Reactor
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, fuel elements of, analysis of burnup of Halden Boiling Reactor
URANIUM OXIDES UO_2—PuO_2–UO_2, fuel elements of, analysis of burnup of Halden Boiling Reactor
ZIRCALOY-2—fuel element cladding of, analysis of failures in Halden Boiling Reactor of
TURBINES—design of Halden Boiling Reactor, effects of fluid flow on optimum (D.C.C.)

35465 (KFK-654) STUDIE UEBER EINEN 527 MW(t) NATRIUMBEHEIZTEN DAMPFERZEUGER UND EINEN 98 MW(t) NATRIUMBEHEIZTEN ZWISCHENUEBERHITZER. (Studies on a 527 MW(t) Sodium-heated Steam Generator and a 98 MW(t) Sodium-heated Reheat Superheater). Cramer, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan. 1968. 121p. (In German). Dep.

The design studies made on a Na/H_2O steam generator and on a Na/H_2O superheater within the framework of the fast breeder project are reported. The design specifications and the selection of the heating surface are described. The construction proposals are developed. Heat transfer calculations were made for the model form selected. A detailed description is given of the characteristics of the individual construction proposals. Conditions for the construction, testing, and acceptance are outlined. A cost evaluation was made for the generator and superheater. (J.S.R.)

35466 (KFK-689) GAS COOLING FOR FAST BREEDERS. Donne, M. Dalle; Wirtz, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Nov. 1967. 14p. (CONF-671102-39). Dep.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Recent developments in prestressed concrete pressure vessels, the use of roughened fuel element surfaces, large gas turbines, and metal-clad, ceramic, and cermet fuels are briefly examined for potential application in gas-cooled fast breeder reactors. To assess the potential of the fuels discussed, some calculations of reactor parameters are presented for 1000 MW(e) power plants. (H.D.R.)

35467 (LA-3952) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING JANUARY 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Feb. 1968. Contract W-7405-eng-36. 10p. Dep. CFSTI.

Data from the final UHTREX critical experiments (UCX-II) are evaluated and compared with UCX-I. Leak tests of the secondary containment are conducted. Results show containment ready for fuel power operation. Improvements in instrumentation and mechanical systems are described. (D.C.C.)

35468 (PNR/SETR-R.-010) INFLUENCE DU MODE D'APLATISSEMENT DU FLUX RADIAL SUR LES CARACTERISTIQUES NEUTRONIQUES D'UN REACTEUR DE 1000 MWe A 2 ZONES. (Influence of the Various Ways of Radial Flux Flattening on the Neutronic Characteristics of a 1000 MWe Two Zoned Fast Reactor Core). Sacriste, C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Dec. 1966. 43p. (In French). Dep.

The radial flattening of the flux of reactors may be realized by "variable enrichment" or by "variable composition" in the 2 zones of the core; comparisons of the neutron characteristics of 1000 MW(e) reactors are presented. The criterion chosen for the comparison of reactors of identical power is the critical mass with the same evolution of reactivity. The methods of calculation and the codes are examined. Results of the comparison are presented. (auth)

35469 (PNR/SETR-R-022) CALCUL D'UNE BARRE DE CONTROLE DE REACTEUR RAPIDE EN THEORIE DE DIFFUSION MULTIGROUPE, AMELIOREE PAR UNE METHODE DU TYPE AMOUYAL, BENOIST ET HOROWITZ. (Calculation of a Fast Reactor Control Rod in Multigroup Diffusion Theory Improved by a Method of the Type Amouyal, Benoist, and Horowitz). Lacapelle, T. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires. Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1967. 46p. (In French). Dep.

It is shown that it is possible to adjust the diffusion coefficients of a homogeneous absorbing rod, in order to get, in a cell geometry multigroup diffusion theory calculation, essentially the same number of captures, hence the same antireactivity, as in a multigroup transport calculation. For each energy group, a "thermal utilization factor" type problem is considered, and the diffusion coefficient of the rod, D_u, is adjusted with respect to the ratio Φ_m/Φ_u of the average flux in the outside medium (m) to the average flux in the rod (u). Taking the asymptotic part of Φ_m, D_u is adjusted with respect to the ratio of the asymptotic flux at the rod surface to the average flux in the rod. This ratio is determined a priori, for each group independently, using the classical Amouyal, Benoist and Horowitz method. A numerical comparison for six different control rods is given. (auth)

35470 (RT/FI-(68)11) HETEROGENEITY CALCULATION IN FAST REACTOR LATTICES. Bitelli, G.; Gandini, A.; Dal Bono, I.; Leproni, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 21p. (PRV-r-(67)15). Dep.

A computer code EDERI is described for calculating heterogeneity effects in fast reactors based on formulations by Storrer. The collision probabilities which are adopted by the code are calculated directly in the case of a slab geometry or evaulated separately. A Monte Carlo method with a peculiar fitting procedure for more complex geometries is described. Comparisons of this method against experimental values of ZPR 3 Assembly 22 are presented. (D.C.C.)

For abstracts of individual papers see: 33662, 35210, 35243, 35344–35349, 35538–35545, 35622–35632, and 35704–35709.

35471 (STI/PUB–165(Vol.1)) FAST REACTOR PHYSICS. Proceedings Series. Proceedings of a Symposium on Fast Reactor Physics and Related Safety Problems held in Karlsruhe, 30 October–3 November 1967. (International Atomic Energy Agency, Vienna (Austria)). 1968. 549p. (In several languages). (CONF-671043–(Vol.1)). IAEA: $11.00; Austrian Schillings 285,-; Pounds 4.11.8; F Fr 53,90; DM 44,-.

Reviews of fast reactor breeder development programs are presented for France, Germany, Great Britain, Japan, and the United States. Other aspects of fast reactor development programs presented include: nuclear data analysis; experimental methods; analysis of zoned systems; and kinetics. Separate abstracts were prepared for the 34 papers included in this volume. (D.C.C.)

For abstracts of individual papers see: 35551–35560, 35640–35657, and 35720.

35472 (STI/PUB–165(Vol.2)) FAST REACTOR PHYSICS. Proceedings Series. Proceedings of a Symposium on Fast Reactor Physics and Related Safety Problems held in Karlsruhe, 30 October–3 November 1967. (International Atomic Energy Agency, Vienna (Austria)). 1968. 588p. (In several languages). (CONF-671043–(Vol.2)). IAEA: $12.00; Austrian Schillings 310, -; Pounds 5.0.0; F Fr 58,80; DM 48,-.

Included are 29 papers on fast reactor physics and safety aspects. Major emphasis is on methods of calculation of the heterogeneity problem, the use of zone techniques in thermal reactors for fast reactor experiments, and theoretical and experimental studies on steam-cooled fast reactors. A separate abstract was prepared for each of the 29 papers. (H.D.R.)

35473 (TID–24366) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1966. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France)). May 1967. 32p. Dep. CFSTI.

Topics discussed include: construction of power plant; fabrication of reactor auxiliaries; research; safety; and financing. (D.C.C.)

35474 (TID–24367) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1965. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France)). May 1966. 60p. Dep. CFSTI.

Topics discussed include: construction of power plant; fabrication of reactor auxiliaries; research; and financing. (D.C.C.)

35475 (TRG-Report–1571) REACTION RATE DISTRIBUTIONS IN THE MATERIALS-TESTING LOADINGS OF THE DOUNREAY FAST REACTOR. Atkinson, H.; Crowe, D. S. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Sept. 19, 1967. 68p. Dep. CFSTI.

Materials-testing loadings in the DFR have increased the difficulty and also the importance of calculating accurate reaction rates. The choice of cross-section data and of calculation method is based on experimental evidence from DFR and from a zero energy assembly on VERA. The data set FD2, with revision of the data for the nickel of the reflector, was used in a method whereby a three-dimensional reactor was represented by a pair of two-dimensional flux calculations. The results are shown to be in satisfactory agreement with experiment. (UK)

35476 (WASH–1096) COOLANT MIXING IN SODIUM COOLED FAST REACTOR FUEL BUNDLES. Todreas, N. E.; Wilson, L. W. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr. 1968. 66p. Dep. CFSTI.

Radial subchannel temperature imbalances can be quite severe in typical fast reactor designs of tight pitch to diameter ratios $(p/d \le 1.20)$. Consideration of mixing between interconnected subchannels is required to avoid the significant design penalties which would otherwise be imposed. The available experimental data and analytic methods for predicting coolant mixing are presented and their deficiencies relative to sodium cooled fast reactor application discussed. Sodium conduction effects, subchannel area changes and forced mixing effects due to grid and wire wrap pin spacing techniques are the key fuel assembly characteristics which must be considered in conducting experiments and formulating analytic methods for fast reactor application. (auth)

35477 (WCAP–3696–7) PRESSURIZED WATER REACTOR pH-REACTIVITY EFFECT. Quarterly Progress Report for the Period Ending March 31, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1968. Contract AT(30-1)-3696. 114p. (EURAEC–2006). Dep. CFSTI.

SAXTON POWER REACTOR—heat transfer in fuel assemblies of, effects of crud chemistry on 3 × 3, (E); power operation during December 1967 and February 1968, description of
REACTOR FUEL ELEMENTS—assemblies of Saxton Power Reactor, effects of crud chemistry on heat transfer in 3 × 3, (E); thermocouple location in Saxton Power Reactor type 347 stainless steel–uranium oxide (UO$_2$), description of
LITHIUM—concentration in Saxton Power Reactor 3 × 3 fuel assembly of, measurements during December 1967 and February 1968 of
BORON—concentration in Saxton Power Reactor 3 × 3 fuel assembly of, measurements during December 1967 and February 1968 of
HYDROGEN IRON CONCENTRATION—measurement in Saxton Power Reactor 3 × 3 fuel assembly of, at 530°F, analysis during December 1967 and February 1968
WATER—electric conductivity at 25°C of Saxton Power Reactor coolant, effects of and chemistry during December 1967 and February 1968 on, (E)
THERMOCOUPLES—performance of Saxton Power Reactor 3 × 3 fuel assembly, analysis of, (E)
REACTIVITY—effects of lithium concentration on Saxton Power Reactor 3 × 3 fuel assembly, analysis of, (E)
HEAT TRANSFER SYSTEMS—temperature transients in Saxton Power Reactor, effects of pH level on trip test, (EIT)
(D.C.C.)

35478 IRRADIATION STABILITY OF ARBUS NUCLEAR REACTOR FUELS. Chushkin, Yu. V.; Davydov, E. F.; Syuzev, V. N.; Kolsov, V. V. At. Energ. (USSR), 24: 385(Apr. 1968). (In Russian).

Radiation effects on the three-layer hexagonal Arbus fuel elements were studied using uranium-alluminum alloy with 35 wt % U as fuel. The maximum fuel element heat flux reached 8×10^4 kcal/m^{2}hr with maximum cladding temperature up to 350°C. The structure and microhardness of the matrix material (78 kg/mm^2) and cladding shell (61 kg/mm^2) were not changed with the burnup up to 3.7% at 350°C. The density of the burned up specimens was determined with the accuracy of ±0.02g/cm^3 at 350, 400, and 450°C was 2.91 g/cm^3 and at 550°C was 2.85 g/cm^3. Heating up to 450°C did not exhibit any changes in the specimens; however, a certain swelling of specimens was observed at 550°C which was probably caused by coagulation of fission gases. (R.V.J.)

35479 FRENCH PROGRAM FOR FAST REACTORS. Pflugrad, K.; Schaller, K. H. (EURATOM–CEA, Cadarache, France). Atompraxis, 14: 170-3(Apr.-May 1968). (In German).

A presentation of the French fast reactor program is given, followed by a short description of the 20 MW-reactor RAPSODIE, including the difficulties and the experience encountered during the rise to full power operation. The logical further development is shown by the example of the 250 MWE reactor, PHENIX. (auth)

35480 SAFETY, EFFICIENCY AND ECONOMY OF NUCLEAR POWER IN USSR. Int. At. Energy Agency Bull., 10: No. 2, 3-8 (1968).

A review of nuclear power development in USSR is presented. Analysis of reliability and costs is presented for planned nuclear power stations. The economic use of fast reactors for USSR power production is discussed. (D.C.C.)

35481 SIMULATION AND CONTROL OF SODIUM-COOLED THERMAL REACTORS. Neuenhain, P. (Technische Hochschule, Munich). Atompraxis, 14: 157-60(Apr.-May 1968). (In German).

Use of an analog computer for the simulation of a sodium-cooled thermal reactor is described. Dynamic response of the reactor is discussed. Effects of moderator temperature coefficients on reactivity are shown. Use of an on-off controller with the reactor is discussed; a block diagram of the reactor and control system is shown. Control optimization is discussed. (M.L.S.)

35482 SIMULATION AND CONTROL OF NUCLEAR POWER PLANTS WITH NATURAL CIRCULATION BOILING WATER REACTORS. Jaschek, H. (Technische Hochschule, Munich). Atompraxis, 14: 161-4(Apr.-May 1968). (In German).

The design and operation of a nuclear power plant necessitates the investigation of the dynamic behavior of the system in its entirety. Many of the controlled elements within the plant are heavily non-linear and thus the classical methods of control theory are inapplicable for such an investigation. In order to obtain an insight into the dynamic behavior of the system, a mathematical model is first formed and then tested with a computer. A mathematical model is synthesized not only for the reactor but also for the pipelines, the valves, and the turbine. With such a model, it is possible to investigate the interplay between the initial pressure regulator and the bypass pressure regulator. Due to the complexity of the problem, a digital computer (APACHE-Program) was used in order to generate a correct and systematic patching of the analog computer. The investigations with the analog computer offer an insight into the dynamics of the non-regulated and the regulated system, as well. By varying the parameters, it is possible to determine the optimal setting of the regulators for a given section. 11 references. (auth)

35483 USE OF NUMERICAL COMPUTERS FOR MONITORING AND OPERATING NUCLEAR REACTORS. Moinereau, P. (Compagnie Internationale pour l'Informatique, Paris). Atompraxis, 14: 165-9(Apr.-May 1968). (In German).

The functions that are usually computer-processed in a reactor are analysed; the organization of the corresponding data-processing system is described. The most important conclusions of the current experiments are outlined. (auth)

35484 NUCLEAR EMERGENCY POWER SUPPLY. Dunsmore, Chester. Power Eng., 72: No. 6, 34-6(June 1968).

Important features of a Na-cooled fast breeder reactor that should be considered when designing an emergency power system are discussed. The advantages to the steam-water cycle of integrating the emergency supply into the normal auxiliary system are examined. (H.D.R.)

35485 THE PRESENT AND FUTURE OF NUCLEAR POWER GENERATION IN JAPAN. Sueta, Mamoru (Japan Atomic Ind. Forum, Inc., Tokyo). Seikyu Gakkaishi, 10: 707-16(Oct. 1967). (In Japanese).

Predicted nuclear power in Japan will be 600,000,000 kW by 1975 and 3,000,000,000 to 4,000,000,000 kW by 1985. At the present, the Tokai power station of JAPC is in operation. The Kansai, Tokyo, Chubu, etc., Power Companies are also either constructing or planning atomic power stations. The main points in Japan's nuclear power generation are the following: change from the import of reactor plants to their domestic production; domestic development of advanced converter and fast breeder reactors; the securing of uranium resources; and the establishment of domestic nuclear-fuel cycles. The present and future of nuclear power generation in Japan are described in Japan's program for nuclear power generation; economy of nuclear power generation; development of advanced converter and fast breeder reactors; the problem of nuclear fuels; and, other problems. (NSA of Japan)

35486 REACTOR-CORE MATERIALS. Nishiyama, Atsushi (Sumitomo Electric Industries, Ltd., Osaka). Genshiryoku Kogyo, 13: No. 10, 17-21(Oct. 1967). (In Japanese).

Materials for the reactor core, excluding the fuel, are generally fabricated and delivered to the users by the so-called fabricators. Some problems in the domestic production of such materials, as viewed by the fabricators, are described in the following: the situation of domestic production of the reactor-core materials (domestic technology of the production of control rods); importance of the irradiation and loop tests of reactor-core materials; development of "(reactor) system engineering" in the fabricators; and, future problems in the development of reactor-core materials (cooperation in the development of domestic ATR and FBR, structure for the domestic production of various kinds in small quantities, and standardization of the analysis, test and inspection of the core materials). (NSA of Japan)

35487 NEW ANTICORROSION METHOD DEVELOPED FOR WYLFA REACTOR PRESTRESSING CABLE SYSTEMS. Corros. Prev. Contr., 14: No. 12, 15-16(Dec. 1967).

Properties of Astrolan 39, a petrolatum compound developed to meet stringent requirements for protection of prestressing tendons in the walls of the concrete pressure vessel at the Wylfa nuclear-power station are described. It incorporates Motostor, an oil-soluble vapor-phase inhibitor, and is pumped into the ducts, where on solidification it retains sufficient flexibility to absorb movement of the tendon strands. The specification included freedom from metallic salts, effectiveness at up to 40°C and 60% relative humidity, compatibility with lubricants, stability under radiation, and long effective life. Astrolan MD 858/3, a solvented coating used to give short-term protection during the fabrication, transit, and storage stages, is also discussed. (Metals Abstr.)

35488 RADIAL SPLIT FLOW BREEDER REACTOR. Kovacic, Evan C. (to United States Atomic Energy Commission). U. S. Patent 3,389,054. June 18, 1968.

A fuel module for a fast breeder reactor in which discrete fuel particles are contained as a settled bed in an annulus formed between two concentric truncated conical screens is described. Liquid metal coolant is passed radially through the bed in direct contact with the fuel particles. (auth)

35489 HOW TO BUY A REACTOR. Gartman, Warren W. (Gilbert Associates, Inc., Reading, Pa.). Power Eng., 72: No. 6, 47-9(June 1968).

The evolution of the nuclear power industry to the point that present light water reactor designs have been largely standardized is examined. The importance of an engineer-consultant to assist the utility in evaluating bids for these standardized nuclear plants is discussed. (H.D.R.)

35490 EXPANDED BED NUCLEAR REACTOR FUEL MODULE. Chamberlain, Harry V.; Edwards, Jack J.; Kovacic, Evan C. (to United States Atomic Energy Commission). U. S. Patent 3,389,053. June 18, 1968.

A fuel module is described, for a fast breeder reactor which is a shell and tube heat exchanger with a liquid metal coolant on the tube side and an expanded bed of fuel particles in liquid metal on the shell side. Baffles are provided to prevent rapid collapse of the expanded bed and to establish an axial temperature gradient in the bed and an eductor is employed for discharge of the bed from the module. (auth)

35491 INDUSTRIAL ASPECTS OF A FAST BREEDER REACTOR PROGRAMME. DISCUSSION. 3RD FORATOM CONGRESS, LONDON, 24–26 APRIL 1967. SESSION I, II, III, IV, V, AND VI. London, British Nuclear Forum, [1967]. 56p. (CONF-670437).

Discussion of the papers presented at the third Foratom Congress on the subject of European fast breeder reactors is included. Abstracts of the papers are presented in NSA separately. (D.C.C.)

35492 THORIUM CYCLE. Went, J. J. (KEMA, Arnhem, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 28, 9-30 (1968). (In Dutch).

The principles, advantages and disadvantages of breeder reactors are discussed. The investment, consumption and production of fissionable material in the presently used reactor types are compared and related to economic consequences. It is recommended that D_2O and high-temperature gas-cooled reactors are used for power production in about 1990 followed by the installation of breeders. (J.J.t B.)

35493 APPLICATION OF ZIRCALOY FOR CANNING OF FUEL ELEMENTS IN WATER-COOLED REACTORS. Van der Linde, A. (Reactor Centrum Nederland, Petten, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 28, 71-96(1968). (In Dutch).

The oxide formation on the walls of Zircaloy pipes, the decrease of the ductility of the material due to H-absorption in the wall, and corrosion at fixation points of the pipes limit the application of Zircaloy for canning of fuel elements. These factors are discussed quantitatively. (J.J.t B.)

35494 CONCPETUAL DESIGN STUDY FOR A 1200 MW(e) HIGH TEMPERATURE PEBBLE BED REACTOR. Kersting, Wolfgang (Kernforschungsanlage, Juelich, Ger.). Nucl. Eng. Design, 7: 345-66(1968). (In German).

A 1200 MW(e) conceptual design study for a high temperature pebble bed reactor is based on the development and design experiences from the AVR experimental power reactor and the 300 MW(e) THTR prototype reactor, and on the construction and operating experience with the AVR. A survey of the German high temperature reactor concept from the experimental power reactor to a commercial power station is given. The step in capacity from 300 MW(e) to 1200 MW(e) takes advantage mainly from the cost degression of the prestressed concrete pressure vessel with increasing reactor power, and from the possibility to scale up nearly all components of the THTR prototype with resulting cost reduction per unit capacity. A short description of the power station with the main design data and a cost evaluation is included. The design and construction of the reactor core are described, with details of the technology and the the thermal behavior of the spherical fuel element, the pebble bed, possible fuel cycles, fuel element charging and treatment, the graphite and carbon structure of the core, and the shut-down and control facilities. The design of the prestressed concrete pressure vessel with the insulated and water-cooled liner, holes and ducts, and internal steel mountings in the vessel is described. The reactor cooling circuit with details of the circuit components, the steam generators, the blowers, the gas purification plant, auxiliary circuits, and the secondary steam circuit is shown. (auth)

35495 COMMERCIALIZING THE SGHW REACTOR. **Engineer, 225:** 805-8(May 24, 1968).

The application to a commercial reactor of the experience gained in the design and construction of the Winfrith prototype is discussed. Special consideration is given to the thermal and hydraulic performance, fuel management, and to the problems of a natural uranium fueled design. (UK)

35496 EUROPEAN FAST REACTOR PROGRAMMES AND ECONOMICS. **Berridge, D. R.** (Central Electricity Generating Board, Berkeley, Eng.). pp 45-8 of Industrial Aspects of a Fast Breeder Reactor Programme. International Reports. 3rd Foratom Congress, London, 24–26 April 1967. Session I, II, III, IV, V, and VI. London, British Nuclear Forum, [1967].
See CONF-670437.

A description of fast reactor development programs in European countries is presented. Analysis of fast reactor power economics is discussed. Fuels and fuel cycles are described for optimum operation. (D.C.C.)

35497 THORIUM-^{233}U REACTORS. **Rennie, C. A.** (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 39-44 of Industrial Aspects of a Fast Breeder Reactor Programme. International Reports. 3rd Foratom Congress, London, 24–26 April 1967. Session I, II, III, IV, V, and VI. London, British Nuclear Forum, [1967].
See CONF-670437.

A discussion of the ten papers submitted on the use of Th and ^{233}U-fueled reactors is presented. Two papers considered heavy water-moderated reactors, one considered molten uranium fluoride reactors, one discussed fast reactors, and six papers considered high-temperature gas-cooled reactors. Operation economics and fuel cycle efficiency are discussed for each type presented. (D.C.C.)

35498 PROTOTYPE DESIGNS. **Hall, W. B.** (Univ. of Manchester, Eng.). pp 23-38 of Industrial Aspects of a Fast Breeder Reactor Programme. International Reports. 3rd Foratom Congress, London, 24–26 April 1967. Session I, II, III, IV, V, and VI. London, British Nuclear Forum, [1967].
See CONF-670437.

Details of four prototype fast reactor designs are presented. Three of these, from France, Germany and the United Kingdom, are for sodium-cooled reactors; the fourth, from Germany is for a steam-cooled reactor. Tables of main parameters are included for each reactor design. (D.C.C.)

35499 FUEL FABRICATION AND REPROCESSING. **Ball, J. G.** (Imperial Coll. of Science and Tech., London). pp 15-18 of Industrial Aspects of a Fast Breeder Reactor Programme. International Reports. 3rd Foratom Congress, London, 24–26 April 1967. Session I, II, III, IV, V, and VI. London, British Nuclear Forum, [1967].
See CONF-670437.

Development programs for fuel fabrication and reprocessing in Belgium, France, Germany, United Kingdom, Italy, and USSR are described. (D.C.C.)

35500 FAST REACTOR DEVELOPMENT OBJECTIVES GENERAL REACTOR CHARACTERISTICS AND FUEL REQUIREMENTS. **Searby, P. J.** pp 3-14 of Industrial Aspects of a Fast Breeder Reactor Programme. International Reports. 3rd Foratom Congress, London, 24–26 April 1967. Session I, II, III, IV, V, and VI. London, British Nuclear Forum, [1967].
See CONF-670437.

A description of design parameters based on economics, availability, and experience for fast reactors is presented. Brief reviews of development programs in various countries are included. Fuel cycle programs for Belgium, France, Germany, and the United Kingdom are described. (D.C.C.)

For abstracts of individual papers see: 35496–35500.

35501 INDUSTRIAL ASPECTS OF A FAST BREEDER REACTOR PROGRAMME. INTERNATIONAL REPORTS. 3RD FORATOM CONGRESS, LONDON, 24–26 APRIL 1967. SESSION I, II, III, IV, V, AND VI. London, British Nuclear Forum, [1967]. 48p. (CONF-670437).

Six papers are included on the subjects of European fast reactors and fuel cycle development programs. Separate abstracts are included for five of the papers. One paper appears previously as NSA 22: 1796. Discussion of the papers is abstracted and appears in NSA separately. (D.C.C.)

35502 STABILITY OF THE STEADY-STATE OPERATION OF POWER REACTORS. **Postnikov, I. S. At. Energ. (USSR), 24:** 397-8(1968). (In Russian).

In his second method, Lyapunov used the one-group diffusion approximation to examine the stability of the steady-state operation of a reactor. The problem was extended to include conditions involving slight deviations of the dependent variables from their steady-state values; the matrix inequalities method of V. A. Yakubovich was used to improve the accuracy of the earlier studies. As an example, a power reactor with fixed fuel and without reflector was chosen as the basis of the calculation; it was assumed that it had a constant diffusion coefficient, using the one-group approximation. It was further assumed that in every point of the reactor, the correlation between ϕ and δk may be described by the usual differential equations with time-independent coefficients; the time of life of the prompt neutron could be neglected. The results agreed closely with those of earlier studies. (TTT)

35503 DEVICE FOR DRIVING A REACTOR CONTROL ROD. **Mikami, Takao** (to Tokyo Shibaura Electric Co., Ltd.). **Japanese Patent 1967-24620.** Nov. 27, 1967. **Filed Aug. 12, 1965.**

In the hydraulic driving device described, the operation for a reactor scram is improved. The pressure, supplied below the piston by the pressurized water in the reactor, is increased. In driving a control rod for a scram by the piston mechanism, the hydraulic pressure under the piston is supplied both from the reactor itself and from outside the reactor. The drive system consists of the following: an "out-of-pile" pressurized-water path entering the space under the piston; a hollow piston-rod which opens into the same space; an "in-pile" pressurized-water path entering the hollow rod at the upper end; and non-return valves installed in the two paths. (NSA of Japan)

35504 A PROTOTYPE PLANT WILL PROVE THE FAST BREEDER REACTOR CONCEPT. **Kelly, J. C. R. Jr.; DeHuff, P. G.** (Westinghouse Electric Corp., Pittsburgh). **Westinghouse Eng., 28:** 21-8(Jan. 1968).

Development of the high-gain fast breeder reactor concept requires the design and construction of a prototype plant. The first phase, now under way, is the conceptual design of a 200 to 400 MWe plant for detailed design and construction by 1970. The reactor will be a single-module core of the multimodule arrangement to be used in a full-scale plant and the coolant will be liquid Na circulated in one or two primary loops. Key aspects that require further development include fuel assembly design, fabrication process development and the irradiation of the mixed Pu–U fuel; Na steam generator and coolant loop components; techniques for refueling and fuel handing; and fission product management systems and maintenance procedures. (BBB)

35505 FAST NEUTRON BREEDER POWER REACTORS: SOME BASIC CONCEPTS. **Creagan, R. J.** (Westinghouse Electric Corp., Pittsburgh). **Westinghouse Eng., 28:** 8-15(Jan. 1968).

The two main nuclear objectives of breeder reactor design are to maintain a chain reaction in fissile ^{239}Pu and provide enough neutrons to convert fertile ^{238}U to fissile ^{239}Pu. The requirements and advantages of fast breeders are discussed. Breeding ratio (ratio of fissile material produced to fissile material destroyed) and doubling time (time required to double the total fissile inventory in the reactor plus that being reprocessed outside) are the most important economic factors. (BBB)

35506 PARTNERSHIP APPROACH WILL ASSURE TIMELY DEVELOPMENT OF THE BREEDER REACTOR. **Simpson, J. W.** (Westinghouse Electric Corp., Pittsburgh). **Westinghouse Eng., 28:** 2(Jan. 1968).

The economic optimization of the development of the breeder reactor is a matter of timing, and it is this timing that is discussed. Only a full partnership between utilities, government, and manufacturers can make economic development of the fast breeder a reality. The electric utility industry now feels that the economic potential of nuclear power may be great enough to warrant nuclear plants for more than half of the generating capacity being ordered. Plants now going into service have ratings as high as 500 MW, and plants are being designed for service in the 1970's with ratings beyond 1000 MW. Corresponding reductions in the cost of nuclear power have been achieved; light-water plants being sold today will generate electricity for less than five mills KWhr. The next generation of high-gain breeder reactors which will make fissionable fuel faster than they burn it should be operating in the 1980's to keep nuclear fuel cycle costs and operating expenses at an attractive level, for if development of the breeder reactor is delayed, a large economic penalty will result. A three-phase program is underway leading to construction of a Na-cooled fast breeder demonstration plant with a rating of 200 to 400 MW which will be the prototype design for a full-scale 1000-MW plant. The first phase of the program is receiving financial support from several utilities, some of which may also provide manpower and a number of other utility companies, along with the Atomic Energy Commission, have been invited to join. Similar cooperation will be required to complete the second and third phases. (BBB)

35507 PRESTRESSED CONCRETE CONTAINMENT BUILDING FOR GENTILLY NUCLEAR POWER STATION. **Laforte, B.; Ziegler, A. (Nenniger and Chenevert, Inc., Montreal). J. Prestressed Concrete Inst., 12: 14-29(Dec. 1967).**

The major problems faced in the design and construction of the containment structure and their respective solutions are: tight, leak-proof enclosure with post-tensioned structure and vinyl epoxy lining; positive design within elastic limit for safety; doubling of cables and special rigging in placing cables; construction schedule with slip form wall construction; grouting cable protection; and single forming of the dome with 30° springing angle. Within the established safety requirements and design criteria, comparisons were made between different types of material, including prestressed concrete, structural steel with shielding concrete, and ordinary reinforced concrete. (BBB)

35508 GOOD BREEDING: HOW WILL FUTURE POWER NEEDS BE PROVIDED. **Kelly, John C. R. Jr. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.) Trans. Ind. Gen. Appl., IGA-3: 476-81(Nov.-Dec. 1967).**

Predictions of the trends in nuclear power in the 1980's are made on the basis of examination of existing trends, extrapolation of those trends in modified form into the future, and estimation of the initiatives which can be brought to bear upon the problem. It is estimated that there will be between 100,000 and 150,000 MW of nuclear capacity installed in the United States by 1980 and that by the year 2000 nuclear power plants will constitute at least 50% of the total capacity of 1,000,000 to 1,500,000 MW. Present use and future role of the light water reactor (LWR) converter plants that employ slightly enriched U which must be processed in gaseous diffusion enrichment facilities are considered. Some important factors which will influence the application of nuclear power in the years after 1980, which are discussed, are: continued overall system and nuclear load growth, limited diffusion plant capacity, ore requirements and available ore resources, size and disposition of the LWR Pu stockpile, and optimum types of reactors for utility system requirements. The nuclear power systems which will be in use in the 1980's and beyond will include the high-gain FBR. With the successful application of the LMFBR, fuel cycle costs of all the existing systems will become stabilized and predictable; without the LMFBR, future fuel cycle costs for the existing converter reactors will be uncertain. The development time required to bring a commercial LMFBR into being is appreciable. Schedule estimates vary from 12 to 20 yr depending upon the approach and level of risk accepted. (BBB)

35509 STABILITY OF NUCLEAR POWER PLANT WITH CIRCULATING FUEL. **Goryachenko, V. D.; Trunin, Yu. F. (Gorky Research Inst. of Physics and Tech., USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk, No. 3, 38-45(1967). (In Russian).**

Equations are written for the dynamics of the active zone of the reactor which includes a heat exchanger in the circuit. These equations are transformed to dimensionless form. The trivial solution of the equations corresponds to a steady-state operation of the reactor. The state of the system at an arbitrary time τ is completely determined by a vector-function, which is considered as a point in functional phase space. It is shown that the fuel temperature and concentration at the exit of the heat exchanger have arbitrary but limited values. On being given the properties of the functional and initial equations, it is shown that whatever might be the initial deviations from a state of equilibrium, the power and other reactor variables tend to steady-state values. (TTT)

35510 XENON INSTABILITY OF THERMAL NEUTRON REACTORS AND METHODS OF STABILIZING THE NEUTRON FLUX DISTRIBUTION. **Postnikov, I. S.; Sabaev, E. F. (Gorky Research Inst. of Technical Physics, USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk, No. 3, 46-52(1967). (In Russian).**

A material balance is written for ^{125}I and ^{125}Xe nuclei, most of the ^{135}Xe nuclei originating from the ^{125}I precursor ($T_{½}$ = 9.7 hr). It follows from this equation that with an increase in reactor power the xenon concentration first decreases because of burnup, but then increases to a new equilibrium value exceeding the former value with accumulation of ^{125}I. This behavior leads to instability of thermal neutron reactors, especially in large reactors. The single-group diffusion approximation can be written in the form: $\nabla\phi + B^2\phi = 0$. Here ∇^2 is the LaPlace operator, and B^2 is the material buckling $B^2 = (k_\infty - 1)/M^2$, where M^2 is the square of the migration length. The material buckling M_2 is a function of neutron flux, xenon concentration, control rod position, and the radius vector. This set of equations is difficult to solve because it is nonlinear and distributed. The methods of solving this set of equations are reviewed with a simplification of the direct method of Lyapunov being selected to analyze the stability of the spacial, neutron flux distribution. (TTT)

35511 DEVELOPMENT OF SATURATED VAPOR TURBINES FOR NUCLEAR POWER STATIONS. **Lepore, Romolo (ENEL, Rome). Elettrotecnica, 54: 571-80(Aug. 1967). (In Italian).**

Fundamental problems, particularly that of humidity, associated with saturated-vapor turbines are discussed. Apparatus and arrangements for extraction of humidity at the first stages is reviewed; separators such as the Brown–Boveri, the high-pressure centrifugal separator, the Peerless condensate separator, and others are described. Improved separators at Garigliano are documented with graphs illustrating the expansion curve (total heat vs. entropy). Poor functioning found in operation of turbines and subsequent modifications to correct such problems are outlined, and recently developed projects are reviewed — particularly those of Oyster Creek and Trino Vercellese, and two new turbines of 773 MW and 1800 rpm, and 720 MW and 1500 rpm, respectively. (BBB)

35512 DUAL-PURPOSE NUCLEAR POWER PLANT WILL BE BUILT BY CONSUMERS POWER. **EEI (Edison Elec. Inst.) Bull., 36: 62(Feb. 1968).**

Plans for the construction of the world's first privately owned, dual-purpose nuclear plant by Consumer's Power Co. are briefly discussed. The facility, to cost $267 million, will be built south of Midland, Michigan. The twin-reactor plant will be the company's third nuclear plant in Michigan and one of the largest nuclear plants yet built. It will generate 1300 MWe. Additionally, it will deliver 4 million lb of steam per hr for industrial use by Dow Chemical Co. in Midland. Total energy capacity is equivalent to about 1.5 million KW. As a dual-purpose plant, it will be capable of producing steam for industrial use and power for the statewide electric system. The installation will use 2 water-cooled nuclear reactors as its source of heat for generation of steam and power. Plans call for the first reactor to become operational in 1974 and the second unit in 1975. (BBB)

35513 WORLD ENERGY RESERVES: PROBLEMS AND PROSPECTS. **Angrist, Stanley W. (Carnegie Inst. of Tech., Pittsburgh). Instrum. Contr. Syst., 40: 87-90(Nov. 1967).**

Energy derived from nuclear fission is beginning to make contributions to electrical power generation in the United States. The 775,000-KW Dresden II plant near Chicago will deliver power at 0.4 cent/KW-hr in 1969. By 2000 all new electrical generating plants built by private power companies will be nuclear powered; 50% of all American homes will be using nuclear generated power. By 1980, 19% of all electricity generated in the U. S. will be derived from nuclear power. Nuclear power supplied 5 million KW-hr in 1965; in 5 yrs it will probably supply 25 million KW-hr. EURATOM will require about 155,000 lb of ^{235}U for power reactors in the next 30 yrs. Nuclear power stations planned in 1965 will cost the coal industry a market of 1.3×10^7 t/yr. Nuclear power plants are being used primarily to generate electricity; the possibility of using waste heat for water desalinization is under study. They cannot fill all energy needs. If all U. S. fossil-fuel-burning plants were replaced by nuclear-fueled plants, these would supply only 27% of the total energy requirements by the year 2000. (BBB)

35514 CORE DESIGN AND PERFORMANCE CONSIDERATIONS OF FAST BREEDER REACTORS. **Wright, James H. (Westinghouse Electric Corp., Pittsburgh). Westinghouse Eng., 28: 16-20(Jan. 1968).**

Problems in developing truly competitive breeder reactors are considered. Design parameters that influence fuel costs become the key considerations, e.g., breeding gain and specific power, as the determinants of the Pu fuel cycle cost. The definitions that cover the more commonly used expressions for doubling time are summarized. Breeder doubling time is the index to the economic potential of the fuel cycle. The relation among investory costs, Pu credit, and specific power are discussed. It is evident that Pu costs must be minimized by designing the breeder with high specific power and high breeding gain. The desirability of high fuel density, high thermal conductivity, low Pu enrichments, and low hot-channel factor in obtaining larger more economic fuel pin diameters are pointed out. It is suggested that a large-scale prototype breeder system should be built to demonstrate the technical features of full-scale fuel assemblies and plant components prior to design of the first commercial breeder plant. (BBB)

35515 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLY. **Thome, P. (to Commissariat a l'Energie Atomique). Canadian Patent 783,671. Apr. 23, 1968. Priority date Dec. 18, 1963, France.**

A fuel element assembly for gas-cooled nuclear reactors is described. It consists of a fuel cluster with at least one support grid, and an outer sleeve fitted with heat insulating packing. This is keyed in position by means of vibration-absorbing material such as graphite felt. The insulating material used may be SiO^2, expanded Al_2O_3 SiC foam, or SiO^2 fiber clad with thin metallic sheet. The assembly described serves to reduce the size, neutron absorption capacity and integrated neutron flux of the heat insulating materials. (F.S.A.)

35516 PARTICIPATION BY SMALL ELECTRICAL UTILITIES IN NUCLEAR POWER. PART 1. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION, APRIL 30, MAY 1, 2, AND 3, 1968. **Washington, D. C., Joint Committee on Atomic Energy, 1968. 762p. GPO $2.50.**

35517 NOTE ON TREATMENTS OF SODIUM VOID REACTIVITY EFFECTS IN A LARGE FAST REACTOR. **Tone, Tatsuzo; Katsuragi, Satoru (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 210-21(May 1968).**

Fine spectra in large fast reactors of various compositions have been calculated by exactly treating slowing down due to elastic scattering of light elements, and the resulting composition-dependent sets of the effective cross sections have been compared with currently typical standard sets. The following results have been obtained: (1) Effective cross sections depend largely on composition. The dependence is large for groups where predominant resonances exist. A composition-independent set underestimates sodium void effect compared with a composition-dependent set, when variations of fine spectrum are considered. Therefore a composition-independent set like YOM is not adequate, especially for a large reactor. (2) In the present standard set, the self-shielding factors of both elastic removal and elastic scattering cross section are treated under the same principle. This procedure is not valid, especially at the predominant resonances they vary inversely to each other with variations of composition. (3) The effective cross section in a blanket region, except close to the interface and boundary, are hardly affected by the buckling assumed, and the effects of buckling on effective multiplication factor as well as the sodium void reactivity effect are small enough to be neglected. (auth)

35518 CONTROL OF NUCLEAR POWER REACTORS. **Siddall, E. (to Atomic Energy of Canada, Ltd.). Canadian Patent 783,668. Apr. 23, 1968.**

A method is described for maintaining a uniform reactivity level in all regions of large reactors. Zr alloy tubes of about 0.125 in. diameter are placed vertically among the horizontal fuel channels in the calandria tank. A series of containers are formed from small sections of these tubes at pre-determined locations. Provision is made for pumping, under He pressure, a neutron-absorbing fluid such as H_3BO_3 in and out of the containers so as to vary the neutron flux as required. A system of inlet tubes, valves, and flux detectors with amplifiers are also necessary to secure a flat reactivity level throughout the whole extent of the reactor core. (F.S.A.)

35519 NUCLEAR REACTOR PLANT. **Kaegi, J. (to Sulzer Brothers Ltd.). Canadian Patent 783,127. Apr. 16, 1968. Priority date Mar. 20, 1963, Switzerland.**

A nuclear reactor plant in which the gaseous heat carrier is at higher pressure than the working medium is described. Leaks in any one of a series of parallel heat exchangers are detected immediately and the faulty part disconnected without appreciable impairment to plant operation by radioactive contamination. Two detectors are described. One indicates a vapor pressure difference in the vaporizable working medium if heat carrier gas has leaked into it. The other measures the pH when CO_2 is the heat carrier and water the working medium. (F.S.A.)

35520 YADERNYE IZLUCHENIYA I ATOMNYE REAKTORY. **(Nuclear Radiation and Atomic Reactors). Shirinov, Kh. Baku, Azerbaidzhanskoe Gosudarstvennoe Izdatel'stvo, 1968. 480p.**

A brief review is given on the characteristics of nuclei and nuclear radiation. Nuclear radiation interactions with matter and methods for recording nuclear radiation are discussed in the first chapter. The second chapter covers the main principles of nuclear power, reactor physics, construction and performance of various type reactors, their fuel elements and the problems of direct conversion of nuclear energy into electrical power, heat transfer, and performance of converters and MHD generators connected to reactors. The third chapter handles the applications of radioactive isotopes and shielding in various industries and technologies. Problems in dosimetry, personnel protection, dosimetric and radiometric devices and instruments are discussed in length. 241 references are included. (R.V.J.)

35521 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1969. PART 1. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION ON GENERAL AND REACTOR DEVELOPMENT PROGRAM, JANUARY 30, 31, AND FEBRUARY 5 AND 6, 1968. **Washington, D. C., Joint Committee on Atomic Energy, 1968. 933p. GPO $2.75.**

35522 UPRAVLENIE YADERNYMI ENERGETICHESKIMI USTANOVKAMI. VYPUSK 2. **(Control System for Power Installations. Issue 2). Kuvshinnikov, B. A. (ed.). Moscow, Atomizdat, 1967. 92p.**

Eight articles are included on the control systems and dynamic characteristics of nuclear power reactors at various conditions of operation methods and types of control. Comparative analysis of two-type coolant temperature control systems and their dynamic characteristics are discussed in the first article. The relay system of coolant temperature stabilization for self-regulating reactor is analyzed in the second article. Dynamic characteristics of a single-loop coolant temperature control system considering the dynamic characteristics as functions of reactor parameters are considered in the third article. The fourth article covers a comparative analysis of various type corrections for the first-loop coolant consumption according to the coolant temperature. Various methods for reactor startup from the subcritical state by constant shifting of control elements are discussed in the fifth article optimum startup time of nuclear reactors under limitations imposed on the magnitude and rate of temperature rise is considered in the next article. The seventh article discusses various operating conditions of the reactor power stabilization system with two control elements and the dependence of the system motion on its parameters. The eighth article describes the dynamics of pulse systems regulating reactor power as a function of system parameters. The main characteristics of the regulating element are also described. (R.V.J.)

35523 IMPROVEMENTS RELATING TO SERVICING ARRANGEMENTS FOR NUCLEAR REACTORS. **Floud, Robin Castle; Sims, John (to Fairey Engineering Ltd.). British Patent 1,116,311. June 6, 1968. Filed May 7, 1964.**

The description of a fueling machine for a pressurized fluid-cooled reactor is presented. The fueling machine is movably mounted above the reactor and has a nose portion extending into the reactor. A flexible fluid conduit system serves the nose portion of the fueling machine. The flexible pipe cooling system consists of multiple rigid pipe sections joined by swivelling couplings. (D.C.C.)

35524 REMOVAL OF HEAT FROM NUCLEAR REACTORS. **Kelso, Edward Albert (to Esso Research and Engineering Co.). British Patent 1,116,479. June 6, 1968. Filed Dec. 19, 1966.**

A heat transfer system for organic-cooled reactors is presented. The system consists of a flowing mixture of liquid hydrocarbons passing through the core. The hydrocarbons are produced by non-catalytic thermal hydrodealkylation of petroleum feedstock. The resulting hydrocarbon mixture has a boiling point range of 650 to 1200°F. (D.C.C.)

35525 PRESSURE TEST ON MODEL OF A NUCLEAR REACTOR VESSEL. **Urban, Antonin (Nuclear Power Plant Div., Plzen, Czech.). Tech. Dig. (Prague), 9: 848-54(Dec. 1967).**

The equipment, instrumentation, procedures, and results of a series of tests on a shortened full-scale model of the pressure vessel for the first Czechoslovak nuclear power station are presented. A tightening test on the bolts which join the vessel head to the shell, a heating test, and a hydrostatic pressure test were carried out. (H.D.R.)

35526 LONG-TERM ECONOMIC SIGNIFICANCE OF GAS-COOLED HIGH TEMPERATURE REACTORS. **Kraemer, H.; Schulten, R.; Wagemann, K. (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 11: 44-53(1968). (In German).**

By model calculations, carried out with the reactor strategy programme of Harde, Memmert, the long-term chances of the gas-cooled high-temperature-reactor with steam- or helium turbine in a utility pool system of the German Federal Republic were investigated. It is assumed that the energy production of this system is also covered by conventional power stations, by light-water-reactors, and after 1980 also by fast breeders of the sodium-cooled type with oxide fuel material. In case that only the amount of fissile material is available which is bred by the system itself (plutonium balance closed) the investigations showed an increased portion of capacity for the high-temperature-reactor run either with thorium or with low-enriched uranium. Under the assumption that any amount of plutonium is available (plutonium balance open), and according to this fact the construction of fast breeders is not restricted and no penalty is placed by the dependance of other plutonium-furnishing plants, this reactor type takes over after the year 2000 the greatest part of capacity if high-temperature-reactors with helium turbine are not taken into consideration. But also in this case the high-temperature-reactor with steam turbine can cover a considerable portion of capacity, which is however mainly restricted on the range of medium load factor. By coupling the high-temperature-reactor with the helium turbine the energy generating costs can be reduced by such an amount that this plant can compete with fast breeders over the whole time-range regarded, also when the plutonium balance is assumed to be open. The savings (present worth in 1970) which can be expected by the introduction of the high temperature reactor in a utility pool system of the Federal Republic exceed in all reactor strategies investigated the costs for the development of this system after 12–15 years of the availability of the high-temperature-reactor. (auth)

35527 FEED CONDITIONS AND WATER AND STEAM RADIOLYSIS SUPPRESSION AT BELOYARSK NUCLEAR POWER STATION. Kot, A. A.; Levich, A. A.; Shchapov, G. A.; Gruzdev, N. I.; Lesunov, I. P. Elektri. Sta., 39: 39-41(Jan. 1968). (In Russian).

The results of investigations into feed conditions at Beloyarsk nuclear power station in conjunction with the radiolysis problem are presented. The study is carried out in two stages: determining the effect of suppressing water radiolysis by means of H_2 in the reactor itself; examining the use of H_2 for suppressing steam radiolysis in the superheater panels. The results obtained are found to be favourable. (auth)

35528 HEAVY WATER REACTORS AND THE MARKET OF CORE MATERIALS. Gaussens, J. (CEA, Paris). Ind. At., 12: No. 3-4, 57-65(1968). (In French).

Various types of reactor cores are discussed; advantages and disadvantages of each are considered. Emphasis is placed on the heavy water reactor. Effects of natural resources on the various types of reactors are evaluated; plutonium recycle is discussed. Thorium utilization with heavy water reactors is analyzed; investment costs for heavy water reactors are listed. (M.L.S.)

35529 FIRST SWISS NUCLEAR POWER CENTRE: BEZNAU (2 X 350 MW). Elmiger, E. (NOK, Baden, Switzerland). Ind. At., 12: No. 3-4, 67-73(1968). (In French).

The site, nuclear system, and safety of the Beznau Power Reactor are described. A schematic of the primary circuit for Beznau-1 is shown. Design parameters of Beznau-1 are tabulated; these include overall plant parameters, core, cooling system, containment vessel, boilers, and turbogenerator parameters. (M.L.S.)

35530 LIMITING FACTORS OF HEAT EXTRACTION FROM THE REACTOR CORE. Van Kuijk, R. M. (N. V. Gemeenschappelijke Kernenergiecentrale Nederland, Dodewaard). RCN (Reactor Cent. Ned.) Meded., No. 26, 45-57(1968).

The design criteria of the boiling water reactor of the GKN Nuclear Power plant presently under completion are discussed. It is concluded that the central fuel temperature and the exit steam volume fraction will limit the heat removal. (J.J.t B.)

35531 FLOW PROBLEMS WITH SUSPENSIONS. Warschauer, K. A. (KEMA, Arnhem, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 26, 59-71(1968).

The measured value of the minimum transport velocity in a circular pipe of a suspension of UO_2-ThO_2-particles at 250°C is about 0.4 times the value calculated from the settling velocity at that temperature and other rheological data at room temperature. These results are applied to a suspension reactor with a spherical vessel with cylindrical in- and outlet pipes. A stream distributor is discussed. The effect of thermal gradients in the reactor vessel and the resulting thermal convections is estimated. (J.J.t B.)

35532 NATURAL CIRCULATION WITH BOILING. Mathisen, R. P. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nukleonik, 11: 16-32(1968).

A number of parameters with dominant influence on the power level at hydrodynamic instability in natural circulation, two-phase flow, have been studied experimentally. The geometrical dependent quantities were: the system driving head, the boiling channel and riser dimensions, the single-phase as well as the two phase flow restrictions. The parameters influencing the liquid properties were the system pressure and the test section inlet subcooling. The threshold of instability was determined by plotting the noise characteristics in the mass flow records against power. The flow responses to artificially obtained power disturbances at instability conditions were also measured in order to study the nature of hydrodynamic instability The results presented give a review over relatively wide ranges of the main parameters, mainly concerning the coolant performance in both single and parallel boiling channel flow. With regard to the power limits the experimental results verified that the single boiling channel performance was intimately related to that of the parallel channels. In the latter case the additional inter-channel factors with attenuating effects were studied. Some optimum values of the parameters were observed. (auth)

35533 PREDICTIONS OF FUEL BURNUP FOR THERMAL REACTORS. Spinrad, B. I. (International Atomic Energy Agency, Vienna). Reactor Fuel-Process. Technol., 11: 69-71 (Spring 1968).

The elimination of errors and optimization of calculations for thermal reactor fuel burnup are discussed for flux and power distribution, reactivity, reactivity lifetime, isotopic buildup and depletion, and power and reactivity coefficients. Recommendations are presented. (D.C.C.)

35534 SUPERHEATING OF LIQUID METALS IN RELATION TO FAST REACTOR SAFETY. Fauske, Hans K. Reactor Fuel-Process. Technol., 11: 84-90(Spring 1968).

Available liquid-metal superheat data are presented. The mathematic expression for superheat requirements for liquid-metal boiling is presented. Comparisons with water superheat are discussed. The effects of aging on liquid metal superheat values are described. Also, variations in superheat measurements due to heating methods are described. The effects of heat flux on liquid metal superheat are presented. Other factors affecting liquid metal superheat include flow rate, pressure, purity, and radiations. 20 references. (D.C.C.)

35535 EFFECT OF THE REACTOR TYPE ON THE FUEL NEED FROM 1970 TO 1995. Haavisto, Heikki. Tek. Aikak., No. 4B, 38-41(1968). (In Finnish).

The nuclear fuel requirements are determined not only by the amount of energy produced, but also by the properties of the reactor plant and, especially, the reactor itself. The fuels and fuel cycles of different types of nuclear power plants differ. Their effect on the economy of the whole nuclear power plant is considerable. For the determination of the effects of different reactor types the amounts of fuel required by the same nuclear power program when realized with different types of plants and combinations of plants have been examined. The basic alternatives chosen are the normal light water plant (LWR), the English SGHWR plant and the Canadian heavy water plant (HWR). Fast breeder reactors have been combined with all the above mentioned alternatives. The examination extends up to the year 1995. (auth)

35536 SPECIFIC DYNAMICS AND LOAD FOLLOWING CAPABILITIES OF THREE NUCLEAR PLANTS. Aalto, Erkki. Tek. Aikak., No. 4B, 10-14(1968). (In Finnish).

The specific load following capabilities of the PWR, BWR and SGHWR plants are described. They are of importance if the plant is to be used for load following (grid frequency control) later on. For this, the required time constant for small load changes in the Finnish national grid is 15 to 25 s. The effective reactivity coefficients and time constants for the three reactors are discussed and typical values are indicated. The specific control principles are described. It is explained why these lead to the PWR's reactor-slave-to the turbine and BWR's reversed control principles. Also, it is explained how the SGHWR can nearly match the PWR because of its nearly-zero void coefficient. The control speed of PWR and SGHWR can be determined by the turbine controller, while the BWR's shortest theoretical time constant is about 10 to 15 s, including 2 to 4 s dead time. It is determined by the thermal inertia of the fuel. (auth)

35537 EXPERIMENTAL RESEARCH OF BOILING WATER REACTOR STABILITY. Afanas'ev, V. A.; Kebadze, B. V.; Sankovskii, G. A.; Gritskov, V. I.; Sokolov, I. N.; Adamovskii, L. A.; Markin, S. A. At. Energ. (USSR), 24: 363-7(Apr. 1968). (In Russian).

The experimental data on the determination of boiling water reactor steady state operation range are presented. The investigation was performed by applying periodical perturbations (reactivity oscillation) and by statistic methods; at a series of operating conditions the reactor power increased to values at which undamping oscillations occurred. Reactivity oscillation experiments and calculations based on the experimental data indicate that undamping oscillations occurrence is mainly due to high reactivity power coefficient. It is shown that the damping time constant of neutron power autocorrelation function can be used effectively for stability threshold prediction. The critical power values obtained at a series of operating conditions give the information which allows stability limit extrapolating for higher pressure range. 8 references. (auth)

35538 FAST REACTOR RESEARCH AND DEVELOPMENT PROGRAMME IN JAPAN. Ishikawa, H.; An, S.; Mishima, Y. (Japan Atomic Energy Research Inst., Tokyo). pp 15-26 of

Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The fast reactor research and development programme, with the stress on fast reactor physics and related safety problems, is described. The 100-MW(th) fast experimental reactor and fast prototype reactor are to be sodium-cooled. The former is scheduled to be critical in 1972, and some of the related R&D activities have already commenced. The prototype is to be developed at the latest by the early 1980's. A prototype advanced converter project is also now under way in Japan, and a new organization was established in October 1967 to develop both the fast reactor and the advanced converter. The JAERI fast critical assembly is scheduled to play an important role in obtaining information on the reactivity effects in large fast reactors, and will be used to check designs of the experimental fast reactor and the prototype fast reactor. Also, other establishments plan to prepare additional experimental facilities for research on this subject. In many establishments theoretical research is increasing on the following topics: nuclear data for fast reactors, fast neutron energy spectrum, reactivity coefficients, design study of large fast reactors, analysis of fast reactor kinetics and accidents. The study of fast reactor safety in Japan is so far mainly confined to the theoretical approach; however, the experimental research programme is also being prepared on such subjects as containment system design studies, sodium technology and fuel development. (auth)

35539 FEDERAL GERMAN FAST BREEDER PROGRAMME. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 3-14 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (EURFNR-403).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The Federal German Fast Breeder Programme started in 1960 at Karlsruhe. The first approach was clearly scientific and concentrated on physics, safety and principal engineering studies. In particular, four major steps were taken in the experimental area: SUAK, STARK, SNEAK, and SEFOR. About 1969/1970 two prototypes of 300 MW(e), one with liquid sodium and one with steam coolant will be built with the objective of demonstrating the breeding and electricity producing potential on a large and significant scale. The sodium prototype will be built by the Konsortium Siemens-Interatom, possibly together with Belgonucléaire of Belgium and the Dutch Neratoom. This steam-cooled prototype will be built by the group AEG/MAN/GHH. Thereafter it is intended to order two demonstration plants of 1000 MW(e) to meet the ultimate objective: to have 1000 MW(e) fast oxide breeder reactors available on a commercial and competitive basis by the end of the 1970s. (auth)

35540 UNITED KINGDOM PROGRAMME IN FAST REACTOR PHYSICS. Campbell, C. G. (Atomic Energy Establishment, Winfrith, England). pp 37-47 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A review of the fast reactor physics programme being undertaken in the United Kingdom is presented. (auth)

35541 FAST REACTOR PHYSICS PROGRAMME OF THE UNITED STATES ATOMIC ENERGY COMMISSION. Loewenstein, W. B. (Argonne National Lab., Ill.); Zartman, I. F. pp 49-60 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The United States of America fast reactor physics program is a broadly based research and development effort that is focused on the major neutronics problems of fast reactor design and operation and aims at providing a sound basis for the large-scale commercial exploitation of fast power breeder reactors. These include the optimization of reactor performance to gain maximum economic advantages from fuel without sacrificing safety and reliability requirements. The major emphasis is on the physics of sodium-cooled systems with lesser effort currently on steam and gas-cooled systems. The continued operation of the fast critical facilities ZPR-III, VI, and XI, as well as the projected operation of the ZPPR, is planned. Much of the work on these facilities is in support of nuclear data verification of nuclear design methods. (auth)

35542 INACCURACIES IN THE CHARACTERISTIC PARAMETERS OF A FAST POWER REACTOR DUE TO THE PREVAILING UNCERTAINTIES IN THE BASIC NEUTRON DATA. THEIR EVALUATION AND THE EXTENT TO WHICH THEY CAN BE REDUCED BY CRITICAL EXPERIMENTS. Barre, J. Y.; Ravier, J. (CEA, Cadarache, France). pp 205-23 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The inaccuracies in the characteristic parameters of a fast reactor due to uncertainties in the basic neutron data, using a generalized perturbation method are described. The results of critical experiments to improve the accuracy of the calculated forecasts and thereby possibly improve the cross sections themselves are presented. (auth)

35543 DATA REQUIRED FOR FAST REACTOR SAFETY ASSESSMENT BY PROBABILITY METHODS. Crickmer, J. R.; Cave, L. (Atomic Power Constructions Ltd., Surrey, Eng.). pp 225-40 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Probability methods for the assessment of reactor safety have been developed in the UK to the point where it is possible to make some quantitative comparisons of the safety of differing reactor types measured against acceptable criteria for a given site. One particular method for rapid assessment of preliminary designs has been used to show those areas of fast reactor physics and kinetics where further work could materially assist the designer by allowing relaxation of the standards required of reactor shutdown and emergency systems without impairing reactor safety. (auth)

35544 INFLUENCE OF TIME-DEPENDENT COUPLING COEFFICIENTS AND DELAY TIMES ON THE KINETICS OF A MODULAR FAST REACTOR CORE. Koehler, W. H.; Ho, C. Y.; Plaza, H.; Poulsen, N. B. (Texas A and M Univ., College Station). pp 529-46 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Previous treatments of kinetics problems in modular and toroidal cores in fast breeder reactors have been based on Avery's coupled kinetics equations for partial integral fission sources. Most of these calculations do not take account of the time dependence of the reactivity coupling coefficients caused by possible flux tilting in an excursion. Furthermore, the effect of time delays for neutrons travelling between the modules, which is expected to be small, is not included in the model itself. The behaviour of two coupled modules is based on the derivation of coupled reactor kinetics equations from the Boltzmann equation. The distribution functions of delay times for neutrons are approximated by delta functions. The calculation is based on the three-group leakage fluxes. Cross-sections are condensed from a 26-group set. Step changes in fission cross-sections are considered as perturbations. Coupling coefficients are calculated using the critical flux distributions and, to show the effect of time dependence, using the asymptotic flux distribution. Finally, a numerical method for solving coupled reactor kinetics equations is outlined. (auth)

35545 STOCHASTIC CALCULATION OF FAST REACTOR GENERATION TIMES. Williamson, T. J.; Albrecht, R. W. (Univ. of Washington, Seattle). pp 513-27 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Multigroup calculations for fast reactors are basically static in character, based on a representation of the system in which 25 or fewer groups are used to describe 5 or 6 decades in energy. While most of the uncertainty in calculations (as exemplified by generation times which are consistently 10 to 20% too low) is due to errors in cross sections, errors may also arise in averaging over broad groups; and in the treatment of elastic scattering by means of computed elastic removal cross-sections. Also, the multigroup method does not permit convenient detailed study of the physics of slowing down in fast reactors. A new approach to calculation of fast reactor temporal and integral properties is described. With this method the neutron slowing down process is treated approximately as a discrete time, discrete state Markov process. Example calculations using the discrete state Markov method have been performed in systems with simple geometry. These calculational results are compared to those of other methods. (auth)

35546 MODAL ANALYSIS OF NEUTRON-FLUX SPATIAL OSCILLATION. Imasaki, Masahide; Yanaru, Torao (Kyushu Inst. of Tech., Kitakyushu, Japan). Nucl. Sci. Eng., 33: 93-105 (1968).

The stability of flux-shaped spatial modes is studied in a Calder Hall type reactor in three dimensions using the homogeneous boundary condition of the reactivity with the following three results: the modal interaction due to coolant flow is also a second-order term in the three-dimensional modal analysis and can be ignored as the first approximation; the Nyquist criterion should be applied to the expression containing the involved transcendental function in the transfer function of the thermal system; and the simple thermal model, which treats only the fuel, moderator, and coolant, is adequate to judge the stability of the mode. The effects of flattening the radius on the threshold value of the moderator reactivity temperature coefficient and on the period of the sustained oscillation have been studied by this method as a function of the eigenvalue, and it has been shown that: the modes with the same order in axial and radial direction form a group; and the modes with the second order in axial direction are more stable than the modes with the first order in axial direction. (auth)

35547 COARSE-GRAINING OF THE HAMILTONIAN IN THE QUANTUM-MECHANICAL FOUNDATION OF NEUTRON TRANSPORT THEORY. Meyer, K. (VEB Kernkraftwerksbau, Berlin). Kernenergie, 11: 106-12(Apr. 1968). (In German).

For a strong foundation of neutron transport equation the coarse-graining of the Hamiltonian postulated by van Kampen is necessary. A useful method has been constructed which corresponds to all demands and allows estimation of the terms neglected. The Hamiltonian applied in macroscopic statistical treatment is valid in an asymptotic sense. (auth)

35548 SOLUTION OF A DIFFUSION-CONVECTIVE CORROSION PROBLEM. Lick, Dale W. (Brookhaven National Lab., Upton, N. Y.); Tunstall, J. N. Nucl. Sci. Eng., 33: 1-6(1968). (K-DP-2652).

A system that involves the attack of water vapor on a graphite cylinder such as occurs in gas-cooled nuclear reactors is described. Its purpose is to describe such a system, develop a mathematical model for it, and provide a means of solving the model. This is accomplished by first discussing the transport and rate mechanisms of the system: convective transport of reactants by an inert flowing stream, solid-state diffusion into a porous conduit, and chemical reaction with the conduit material. Based on these mechanisms, mass balance equations are written which give a mathematical description of the system. This mathematical model is then solved by two essentially different numerical techniques. (auth)

35549 THE SELECT COMMITTEE'S FIRST REPORT. Lubbock, E. R. Chartered Mech. Eng., 15: 102-6(Mar. 1968).

A Parliamentary Committee report of an inquiry into the U.K. nuclear reactor program is discussed. The investigation was prompted by criticism of the heavy investment in gas-cooled, graphite-moderated reactors and suggestions that a more diversified approach, including development of water-moderated reactors, would have provided a more economical type of reactor, with cost advantages over contemporary fossil-fuel stations. Rebuttal to this criticism is presented along with an outline of accomplishments of the U.K. Atomic Energy Authority in the power reactor field. (TSS) (BBB)

35550 POWER REACTORS OF THE WORLD. Int. At. Energy Agency Bull., 10: 20-6(1968).

The power reactors operating or under construction in IAEA member countries are tabulated as to name, location, type, power output, and date of criticality. (H.D.R.)

35551 STUDY OF THE HEAT-RELEASE DISTRIBUTION IN FAST REACTORS WITH ABSORBER RODS. Bondarenko, V. V.; Voropaev, A. I.; Zinov'ev, V. P.; Koloskov, B. V.; Polivanskii, V. P.; Troyanov, M. F.; Khalov, E. M.; Shagalin, N. M. (Physical-Energy Inst., Obninsk, USSR). pp 305-16 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In Russian). (ANL-Trans-542).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

Results of experimental and theoretical studies of the heat-release distributions of various BFS critical assemblies simulating the BN-350-type reactor are given. The case of centrally arranged single absorber rods containing different amounts of B was considered and the corresponding calculations made. The calculational design of a reactor with eccentrically arranged single rods or with a group of distributed rods necessitates the use of two-dimensional methods. The method of few-group calculations for a reactor with cylindrical geometry using the diffusion approximation is presented. Experiments are described on the distribution of the heat-release field in a critical assembly with a single eccentric B rod. For analyzing the effect of inserting a system of shim rods, a special critical assembly was selected with six B compensators. The heat-release distribution was measured on this assembly in different directions with the rod system inserted and extracted. A short description of this assembly is given together with the design model used. The theoretical and experimental results are compared and it is found that the method used can be adopted for optimizing the arrangement of the absorber rods for burnup compensation in fast power reactors. (auth)

35552 THE LONG-TIME BEHAVIOUR OF FAST POWER REACTORS WITH Pu-RECYCLING. Jansen, A. (Kernforschungszentrum, Karlsruhe, Ger.). pp 287-304 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (EURFNR-399).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

A study is made of the long-time behavior of fast power reactors with Pu-recycling, taking into account the internal core and blanket management and the external management of the fuel concerning the reprocessing and refabricating plants. The investigations are based on a suitable reactor model which includes a cylindrical reactor core, an axial and radial blanket, and the external plants for reprocessing the irradiated fuel and refabricating the fuel elements. Charging and discharging of the core and blanket elements are treated as discontinuous processes. The calculation of the U and Pu output of the core and blankets at a given time is performed in two steps: first the well-known burnup equations for the fuel with space-dependent coefficients are solved, yielding the space-dependent U and Pu concentrations in the irradiated and discharged elements. Then the total U and Pu content of the discharged elements follow by volume integration. The coefficients of the burnup equations are determined by the one-group neutron flux $\phi(r,z)$ and the microscopic one-group cross-sections $\sigma(r,z)$ for absorption and capture at the points of neutron irradiation. To limit the numerical efforts by calculating the long-time behavior, the one-group constants are regarded as time independent. The feedback of the burnup of the fuel on the neutron flux and spectrum can be taken into account for a first-order approximation by calculating the one-group constants for an average burnup state of the reactor. By this procedure it is possible to calculate the U and Pu content of the discharged elements with sufficient accuracy. The one-group neutron flux of the average state of the reactor is normalized to the given total power of the reactor. From these conditions, the U and Pu output of the core, axial and radial blanket are calculated as functions of time, thereby taking the time-dependent initial composition of the core elements into account completely. The initial composition of the fuel elements is recalculated for every fuel cycle by satisfying two algebraic conditions for each core zone. The first condition maintains criticality of the reactor by keeping the difference of neutron production and consumption per cm^3 and sec constant in respect to time. The second condition keeps the total number of the heavy nuclei per cm^3 constant. The breeding gain is also determined by these conditions. The numerical results for a 1000-MW(e) sodium-cooled reactor show a strong coupling between the operation of the radial blanket by joint reprocessing of the core and radial blanket elements. This is shown by the time dependence of the Pu-isotope composition in the fresh and irradiated fuel elements. Furthermore, it is shown that this time behavior leads to time variations of the amount of Pu which must be charged into the core for criticality, and the breeding gain of the system. (auth)

35553 RECENT DEVELOPMENTS IN THE PHYSICS OF DOUNREAY FAST REACTOR OPERATION. Tait, D.; Edwards, A. G. (United Kingdom Atomic Energy Authority, Caithness, Scotland). pp 275-85 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The physics work on DFR is largely concerned with the operation of a fast power reactor as an irradiation facility. The experimental rig loading has been increased by minimizing the reactivity margin required to run the reactor. This has been achieved by conducting a preliminary approach to critical before each run to verify that enough reactivity is available and by making careful measurements of the reactivity in hand on the reactor during a run to obtain a better estimate of the reactivity loss with burnup. Present knowledge of neutron and γ fluxes on the reactor is described. A method of checking rapidly the reactivity feedback is now being used. Random noise in flux and temperature signals have been recorded and analyzed to produce auto- and cross-correlograms which can be interpreted to some extent in terms of reactor properties. Reactor operation has been simplified by replacing the artificial source by one of metallic beryllium which provides an adequate flux of photoneutrons due to fission-product gamma activity. Finally, some deductions from the performance of the delayed neutron detectors monitoring the liquid metal coolant are reported. (auth)

35554 SYSTEMS ANALYSIS OF A FAST STEAM-COOLED REACTOR OF 1000 MW(e). Smidt, D.; Frisch, W.; Hofmann, F.; Kiefhaber, E.; Moers, H.; Schramm, K.; Spilker, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 475-96 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The Karlsruhe design of a steam-cooled fast reactor (D1) has been the subject of a system analysis. Here the dependence of fuel inventory, breeding ratio, rating, core geometry and plant efficiency on coolant pressure, and coolant temperature has been studied for two different rod powers. The effect of artificial surface roughness has been investigated. For some configurations the resulting fuel-cycle and capital costs have been determined and discussed. The main influence results from pressure. The lower pressure allows for higher breeding ratios, but lower efficiencies and vice versa. From this the fuel-cycle costs show an optimum at around 150 atm abs. The capital costs on the other side decrease with pressure. The overall optimum of the power generating costs for the presently studied parameter range is at about 170 atm abs, a coolant outlet temperature of 540°C and a rod power of 420 W/cm. Artificial roughness (boundary layer type) leads for a required system pressure and outlet temperature to a larger coolant volume fraction and, therefore, to reduced breeding ratios but higher efficiencies. As another part of the work some stability characteristics of the cores were studied. The dependence of the core stability on the varied parameters is shown. (auth)

35555 PARAMETRIC STUDY OF THE DYNAMIC BEHAVIOUR AND STABILITY OF A STEAM-COOLED FAST REACTOR WITH AN INTEGRATED COOLING CYCLE. Huebschmann, W.; Erbacher, F.; Frisch, W.; Malang, S.; Ritz, L.; Woite, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 451-74 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

It is shown that in a steam-cooled fast breeder reactor it is possible, in principle, to produce inherent stability and safety from accidents by the feedback of the cooling cycle on the core. The effects of various parameters on stability and safety are determined for the following disturbances: reactivity disturbance, blower failure, load changes, various pipe ruptures, and inadvertent fast unflooding. Trends and limits are put forward that should be observed in the design of the components and the arrangement of the cooling cycle. In particular, it is shown that a cooling cycle integrated in a common pressure vessel produces easily inherent stability and safety of a steam-cooled fast reactor. (auth)

35556 REACTIVITY COEFFICIENTS OF STEAM-COOLED FAST BREEDERS. Kiefhaber, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 413-28 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (EURFNR-398).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The influence of several design parameters on some nuclear quantities which are related to the safety and stability of a steam-cooled fast breeder is discussed. Almost all results refer to a 1000-MW(e) plant. Two of the most important quantities for the stability behavior of such a reactor, which are derived from the nuclear calculations, are the Doppler coefficient and the steam-density coefficient of reactivity. In addition there are several other nuclear quantities related to the safety of a steam-cooled fast reactor: the criticality changes upon loss of coolant, or flooding in the axial or radial direction. Two design parameters of great influence are the composition of the plutonium isotopes and the burnup or the fission products: going from pure ^{239}Pu to "dirty plutonium" with a ^{240}Pu content of 30% decreases the criticality in the flooded state by an amount of 20 to 25%. Taking into account the fission products corresponding to an average burnup of 50,000 MWd/t results in a criticality change of about 5% in the same state. The influence of both design parameters on the criticality change belonging to the loss-of-coolant accident, although smaller in magnitude, is of equivalent importance. The combined effect of both parameters causes a change of sign for the steam-density coefficient which in most cases has unfavorable effects on stability. In this connection one has also to take into account the type of material used for structure and cladding. The type of coolant (H_2O or D_2O) is the design parameter with the greatest influence on the Doppler coefficient. The geometrical configuration of the reactor and the coolant pressure are further parameters which are considered with respect to safety. (auth)

35557 REACTIVITY DEPENDENCE OF COOLANT DENSITY IN STEAM-COOLED FAST REACTORS. Jirlow, K. (AB Atomenergi, Stockholm). pp 399-411 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The variation of reactivity with steam density has been studied for some typical steam-cooled designs for both H_2O and D_2O steam. The Speng code (spectrum program in the B_1-approximation), the one-dimensional diffusion code Monday and the one-dimensional S_n-program DTF IV have been used for the calculations. A general result is that for practical Pu compositions in the fuel all "normal" designs of large oxide reactors will show increase in reactivity with decreasing steam density, or in other words, the steam (density) coefficient $dk/d\rho$ is negative (or the "void" coefficient is positive). The reactivity dependence is very sensitive, in particular for H_2O steam, to the relative amount of ^{240}Pu as well as of the amount of fission products in the core, i.e., the average burnup. In general the size of the steam coefficient decreases with increasing core buckling (neutron leakage) and operating steam density, whereas it gets larger with increasing ^{240}Pu content and burnup. In comparing H_2O and D_2O, for typical values of ^{240}Pu content, the D_2O steam coefficient is less negative than that for H_2O. This difference in steam coefficient between H_2O and D_2O increases with burnup. Flooding with H_2O or D_2O of a typical steam-cooled core with equilibrium fuel will introduce a reactivity decrease of the order of 10%. (auth)

35558 METHODS OF CALCULATION USED IN DESIGNING LARGE FAST-NEUTRON POWER REACTORS. De Myttenaere, P.; Egleme, M.; Goldschmidt, P.; Pilate, S.; Quenon, J.; Renard, A.; Stievenart, M. (Belgonucleaire, Brussels). pp 377-97 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

Numerous codes have been devised in Belgium for calculations of fast-neutron power reactors. These codes are divided into three categories: neutron calculations, safety calculations, and economic calculations. The methods developed and programmed for studying the neutron properties of fast reactors form a large complex of interconnected codes. The basic data for these codes are contained in a collection of 26-group sections, which are combined either with the PANOPLIE code, to solve diffusion equations, or the DTF-4 code, to solve transport equations. It is thus possible to determine the neutron distributions and importance values needed to establish the reactor parameters, power distributions and reactivity effects. Fuller information on the effects of geometry, power distribution and coolant voids is obtained with the two-way PANDA code, for which the PANOPLIE code provides the sections with a few groups and which makes possible the use of a triangular matrix. The effects of growth in reactor power and the appearance of fission product are studied with the PENDULE code, which follows the reactor's operation and permits the study of partial reloadings. Three safety codes are in use or under development. The PROFUSION code was written to study the evolution of an oxide-fueled fast reactor in cases of over-pressure and flow losses. It permits the calculation of the transitory melting phenomenon and possible fuel displacement. The code is suitable for investigating the beginning of accidents of the meltdown type. The PANIC code was developed to assess energy release in a fast reactor in which reactivity is inserted rapidly. It is suitable for studying the standard meltdown accident but can also be used to study the onset of sodium expulsion accidents. The CARMEN code, which is under development, will have wider applications; it will be suitable for calculating accidents liable to occur in a fast reactor. These include accidents of the reactivity-insertion, coolant-loss and assembly-blockage types. This code can be used to calculate the kinetics of a fast reactor, taking sodium expulsion into account. The CORCYRE code was devised for parametric studies on fast reactors. It consists of two parts: with the first the reactor characteristics are determined, and with the second the fuel cycle characteristics and the fuel cycle cost characteristics are calculated. Examples are given to illustrate the use of these codes and indicate the stages in the complete study of a fast power reactor. (auth)

35559 REDUCING THE VOID EFFECT IN A LARGE FAST POWER REACTOR. Spenke, H. (Siemens AG, Erlangen, Ger.). pp 365-76 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The coolant void effect has been recognized as one of the most serious safety problems of large, liquid-metal-cooled fast power reactors. Several proposals have been made to reduce the positive void reactivity effect. However, in all cases appreciable penalties with respect to internal breeding ratio, fissile inventory and, finally, economics have to be paid. All these proposals, like the pancake core reactor and the annular core reactor, have in common that neutron leakage out of all core zones is artificially increased. Some more detailed calculations of voiding characteristics of large Na-cooled fast reactors with cylindrical cores indicate that the most important positive contribution to the void reactivity effect arises in the central core zone. Consequently it appears promising to reduce the void effect considerably by increasing deliberately neutron leakage only out of the central core region and not necessarily out of all core regions. Compared with other geometries discussed this suggestion should result in better breeding and economical performance concurrent with a satisfactory void effect. To support this proposal an investigation was conducted on some significant reactor data (breeding ratios, fissile enrichment, power distribution, etc.) for three geometrically different Na-cooled fast breeder reactors with a power of 1000 MW(e) each. In the first case a normal cylindrical core geometry (2 core zones, 1 axial and 1 radial blanket) with an H : D ratio of roughly 0.33 was considered. The second reactor was similar to the first, except that the height of the inner core zone was reduced by approximately 50% to enhance neutron leakage in the core center, the lost core volume being balanced by increasing the outer radius of the second core zone. The third reactor had an annular core with with dimensions consistent with those of the first reactor. Results show a remarkable improvement in the void effect of the variable-core-height reactor compared with the first reactor, but obviously at the cost of a somewhat higher enrichment in fissile Pu. To achieve a comparably good voiding behavior in an annular core reactor a higher Pu enrichment than in the second reactor would be necessary, with the consequence of lower internal breeding ratio and higher fissile inventory. (auth)

35560 METHODS FOR ESTIMATING THE SODIUM TEMPERATURE COEFFICIENT OF A FAST REACTOR. Wardleworth, D.; Ingram, G. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 343-63 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

Calculations of the sodium temperature coefficient of the United Kingdom Prototype Fast Reactor use multigroup diffusion theory and first-order perturbation theory. These approximate methods have been tested firstly, by comparison with transport theory and exact perturbation theory and secondly, by comparison with experiments in Zebra Assembly 7, which was designed to simulate the Prototype Fast Reactor. Additional calculations are required to treat the heterogeneity effects produced by the plate structure of Zebra and these have also been tested, primarily by comparison with measurements in ZPR-VI. It is shown that, with present techniques, there is an uncertainty (confidence limit) of $\pm 2.6 \times 10^{-4}$ δk/°C in the calculated sodium temperature coefficient of the Prototype Fast Reactor. (auth)

Marine and Portable Power Reactors

Refer also to abstract 34096.

35561 (AD-663550) PRESSURE VESSEL SURVEILLANCE PROGRAM FOR THE ARMY MH-1A FLOATING NUCLEAR POWER REACTOR. Serpan, Charles Z. Jr.; Watson, Henry E. (Naval Research Lab., Washington, D. C.). Sept. 22, 1967. 35p. (NRL-6604). CFSTI.

The pressure vessel surveillance program for the Army MH-1A, barge-mounted reactor was designed by NRL. The NRL-fabricated hardware for the surveillance program included two capsules for vessel wall locations in the reactor, two capsules for accelerated exposure locations, and six capsules for above-core, thermal control locations. Schematic drawings indicate the relative location of the test specimens, neutron flux monitors, and temperature monitors in each capsule section. The manufacturer of the vessel saved the reactor nozzle cutouts from the upper shell-course ring forging for test purposes. The Charpy V-notch and tensile specimens contained in the capsules were machined from one of these reactor nozzle cutouts. Schematic drawings show the location of each test specimen in the parent material. Selected Charpy-V and tensile specimens have been tested to develop preirradiation properties of the AISI 316 stainless-steel reactor vessel for future reference. (auth)

35562 (AD-666202) 1967 SUMMARY REPORT, ENVIRONMENTAL MONITORING PROGRAM. Report for January 1-December 31, 1967. Clements, Lynn C. (Army Engineer Reactors Group, Fort Belvoir, Va.). Feb. 1968. 23p. (ED-6803). CFSTI.

Presented are tables of the data collected during the period 1 January 1967 to 31 December 1967 and statistical analyses and comparisons with data collected since January 1965. It is concluded that the effect of operation of the SM-1 and MH-1A reactors on the radiological background is inconsequential. (auth)

35563 DESIGN OF A MARINE NUCLEAR POWER PLANT UTILIZING THE DIRECT BRAYTON CYCLE. Gathy, Bruce Stephen. Ames, Iowa, Iowa State Univ., 1967. 189p.

Thesis.

A conceptual design for the power plant of a passenger ship is presented. A gas-cooled reactor, gas-turbines and a waste-heat boiler are used in conjunction with a direct Brayton cycle. The steam ship ROTTERDAM is used as the prototype ship. The nuclear main propulsion machinery is 3.9 million dollars higher in cost than the steam propulsion machinery. With a burnup of 23,000 MWD/MT, the annual nuclear fuel cost is 22% less than that for the conventional fuel and the annual operating cost is only 6% higher for the nuclear ship. The nuclear plant has an efficiency of 55% while the oil-fired plant efficiency is only 21%. (Disser. Abstr.)

35564 OUTLINE OF NUCLEAR SHIP HOME PORT. Nishibori, Eizaburo; Onodera, Akira. Nippon Genshiryoku Gakkaishi, 10: 129-36(Mar. 1968). (In Japanese).

Brief description is given of the plan of construction of the projected servicing home port for the nuclear ship. The location selected is the Port of Ominato in the northern part of Honshu and will be constructed in parallel with the building of Japan's first nuclear ship. The port will support the operation of the nuclear ship with her shore servicing facilities, which will be prepared to refuel the marine reactor and treat radioactive wastes, as well as repair the reactor plant when necessary. Among the major facilities to be constructed are a wharf crane, a service building for fuel handling and storing facilities, a waste treatment plant, a sub-station and an office building. (auth)

Rocket and Space Reactors

35565 (AD-661221) BETA DOSE RATES OF PARTICULATE EFFLUENT FROM PHOEBUS 1B EP-IV. Pestaner, J. F.; Cordova, H. I. (Naval Radiological Defense Lab., San Francisco, Calif.). June 15, 1967. Contract AT(49-5)-2505. 26p. (USNRDL-TR-67-110). CFSTI.

Beta dose rates, γ spectra and decay of effluent particles from the PHOEBUS 1B EP-IV reactor test run were measured. These measurements are an extension of the beta hazard prediction studies which have thus far consisted of theoretical and empirical calculations for the dose rates from unfractionated spherical C-coated UC fuel particles. A theoretical treatment of the beta dose rate to tissue from actual effluent fuel particles requires knowledge, not yet available, of their fission-product fractionation, radionuclide distribution and shape. On the other hand, empirical calculations of beta dose rates of actual effluent fuel particles based on calibrated field measurements with simple, rugged instruments would provide a more direct method of evaluating the hazard in a particular situation. Development of such a system would require coordinated field and laboratory measurements on a variety of effluent particles. The results of the initial phase of the study to provide such a system for beta dose-rate determinations are presented. (auth)

35566 (LA-DC-9460) USE OF AN ON-LINE COMPUTER IN THE TESTING OF PHOTOTYPE NUCLEAR ROCKET ENGINES. Henshall, J. B.; Elkins, E. P.; Carlson, W. F. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 5p. (CONF-680609-3). Dep. CFSTI.

From AIAA 4th Propulsion Specialist Conference, Cleveland, Ohio.

A process computer has been incorporated in the testing of prototype nuclear rocket engines. The type of testing which led to the need for a computer is reviewed, and the testing philosophy which gave rise to its applications is discussed. The basic computer has a 16-bit word with a 16K word core memory with analog and binary input and output capability, a disc storage unit, magnetic tape input-output and two CRT displays. An executive system is employed to monitor various requests for data and assign computing priorities to assure that data and control functions are generated in the correct sequence. The computer is used to generate the run profiles which control the demanded values of various reactor and facility parameters during testing Ten profiles are generated simultaneously by approximating the desired curve by a series of small steps which are suitably smoothed to satisfy control requirements. (auth)

35567 (LA-DC-9555) SCALE MODEL TESTS OF A NUCLEAR ROCKET EXHAUST SCRUBBER. Boyer, Keith; Fenstermacher, Charles; Bryant, Ernest; Meier, Karl (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 10p. (CONF-680609-1). Dep. CFSTI.

From AIAA 4th Propulsion Specialist Conference, Cleveland, Ohio.

Measurements made during ground tests of Rover and Nerva nuclear rocket reactors, have shown that significant amounts of fission products are released from the fuel elements into the exhaust of the rocket and that these fission products can be carried considerable distances by atmospheric winds. An investigation was made to determine the feasibility of reducing this fission product release to the atmosphere. A concept based upon a water scrubbing system was developed and shows promise in achieving this goal. A furnace was built to produce simulated nuclear rocket exhaust containing fission products at design conditions. The effluent from this furnace was run through a scale model scrubber. Several runs were made and the results indicate that about 80% of the fission product iodine and its precursors, as well as other fission products, can be removed from the exhaust-gas stream by this method. (auth)

35568 (LA-DC-9589) STATUS OF THE LOS ALAMOS NUCLEAR ROCKET PROGRAM. Durham, Franklin P. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 5p. (CONF-680609-2). Dep. CFSTI.

From AIAA 4th Propulsion Specialist Conference, Cleveland, Ohio.

The effort in the Rover program at the Los Alamos Scientific Laboratory during the past year has been divided between preparing for the Phoebus 2A 5000 megawatt reactor test and the development and evaluation of improved fuel elements and reactor support materials. Phoebus 2A, which is now ready for testing, has been designed for the highest power, power density, and chamber temperature in the Rover program to date. Facility modifications and checkout have been completed with a dual turbopump feed system capable of delivering 285 lb/sec of liquid hydrogen at 1300 psi. To provide a realistic environment for fuel element evaluation a small, fuel element test reactor, Pewee 1, has been designed and fabricated with a first test planned late in the year. Significant progress has been made in the development of zirconium-uranium-carbide/carbon composite fuel elements that offer the promise of longer operating life than the present graphite-based fuel elements with a modest increase in temperature. Progress has also be made in the pure zirconium-uranium carbide system that will be capable of significantly higher temperatures than the present elements for useful operating times. (auth)

35569 (N-68-10429) MISSION ORIENTED ADVANCED NUCLEAR SYSTEM PARAMETERS STUDY. VOLUME III. PARAMETRIC MISSION PERFORMANCE DATA. Final Report. Chovit, A. R.; Kylstra, C. D.; Fiscus, R. D. (Space Technology Labs., Inc., Redondo Beach, Calif.). Mar. 1965. Contract NAS8-5371. 461p. (NASA-CR-89985; STL-8423-6007). CFSTI.

The results obtained from a comprehensive, parametric lunar and interplanetary mission analysis are presented. The results are primarily presented as the minimum gross vehicle weight in earth orbit versus various missions, vehicle configurations, or propulsion system performance parameters. These results were generated over 20,000 mission simulations performed on the IBM 7094 with the optimum trajectory and vehicle determined for each simulation. The definitions, scaling laws, constraints, and criteria used in these computations are given. (auth)

35570 (N-68-10561) INVESTIGATION OF RADIANT HEAT TRANSFER TO PARTICLE-SEEDED GASES FOR APPLICATION TO NUCLEAR ROCKET ENGINE DESIGN. Keng, Edward Y. H.; Orr, Clyde Jr. (Georgia Inst. of Tech., Atlanta). Nov. 1967. 50p. (NASA-CR-953). CFSTI.

The objective of this research is to provide fundamental information on radiant heat transfer to aerosols to aid in the evaluation of various gaseous core nuclear rocket concepts. Both theoretical and experimental investigations have been pursued. View factors have been evaluated for a number of conditions considering a cylindrical geometry for the system, such results being generally applicable to high temperature technology. The experimental results agree well with theoretical predictions. A new aerosol generator has been designed to produce dense yet uniform aerosols, and preparation for the study of particle evaporation or sublimation in an intense radiant field is underway. An electrically heated tungsten furnace for this investigation is being assembled. (auth)

35571 (N-68-10931) NUCLEAR CRITICALITY STUDIES OF SPECIFIC NUCLEAR LIGHT BULB AND OPEN-CYCLE GASEOUS NUCLEAR ROCKET ENGINES. Latham, T. S. (United Aircraft Corp., East Hartford, Conn.). Sept. 1967. Contract NASw-847. 56p. (NASA-CR-90112; F-910375-2). CFSTI.

Analytical studies were conducted to determine the U-233 critical mass requirements for two specific vortex-stabilized gaseous nuclear rocket engines: a nuclear light bulb engine and an open-cycle engine. The specific open-cycle engine employs a single cylindrical cavity having both a length and a diameter of 6 ft. The specific nuclear light bulb engine employs seven separate cavities, each having a length of 6 ft; the total volume of all seven cavities approximately equals the volume of the single cavity of the open-cycle engine. The nuclear light bulb engine employs BeO between the unit cavities, layers of BeO and graphite surrounding the assembly of seven unit cavities, a relatively large amount of neutron-absorbing structural material in the end walls, seven separate exhaust nozzles, fuel and propellant injection ducts, and hot gases in the propellant and fuel regions. The open-cycle engine employs layers of BeO, graphite, and heavy water surrounding the cavity; various structural materials; an annular exhaust nozzle; fuel and propellant injection ducts; and hot gases in the propellant and fuel regions. (auth)

35572 (SAN-679-4) DESIGN STUDY [OF] ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. POWER CONDITIONING: PARAMETRIC SCREENING STUDY. Swiderski, E. F.; Gyurek, J. W. (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). Sept. 15, 1967. Contract AT(04-3)-679. 411p. Dep. CFSTI.

Results of the parametric studies to determine minimum system weight as a function of electrical component rating, voltage and frequency are presented on power conditioning and power distribution equipment for 0.25 to 10.0 mw space nuclear electric power plants utilizing the Rankine conversion cycle. The power conditioning and distribution equipment includes frequency changers, transformers, rectifiers, and transmission lines. The complete results on the parametric studies for the above equipment are presented. (auth)

35573 (TRW-690-32) MERCURY BOILER DEVELOPMENT ON THE SNAP 2/MRPC PROGRAM. Topical Report No. 34. Ziobro, R. J.; Koestel, A. E. (TRW Equipment Labs., Cleveland, Ohio). June 3, 1968. Contract AT(04-3)-690. 123p. (TRW-ER-7252). Dep. CFSTI.

The entire SNAP 2/MRP boiler research and development program from 1958 through 1967 is summarized. The heat transfer, hydrodynamics, mechanical design, test results, and metallurgical results are presented in a chronological sequence with the text material abstracted from previously published reports. An assessment of the current status of the developed boiler hardware and the boiler design technology is made. (auth)

35574 NUCLEAR REACTOR CORE FOR A ROCKET. Rom, F. E.; Lietzke, A. F.; Hyland, R. E. (to United States Atomic Energy Commission). U. S. Patent 3,374,148. Mar. 19, 1968.

A nuclear reactor rocket core comprised of a plurality of fuel elements in the form of plates of a UO_2–W matrix clad with W is described. The plates are stacked in a spaced relationship to provide a passage for the rocket's liquid propellant. (auth)

35575 GASEOUS CONTROL SYSTEM FOR SPACEBORNE REACTORS. Davison, H. W. (Lewis Research Center, Cleveland). Space/Aeronaut., 49: 100-6(Feb. 1968).

Use of ^{3}He as a neutron absorber in nuclear reactors for space applications is reported. With this system, the reactivity of the reactor is controlled by varying the pressure and density of stagnant ^{3}He gas contained in tubes that are uniformly distributed throughout the reactor. The principal advantages of ^{3}He over control rods are: perturbations of the power and temperature distributions in the reactor are held to a minimum; and the valving system for ^{3}He is less complex and requires less space than a corresponding control-rod drive mechanism. Helium-3 was selected for this gaseous control system because of its high absorption cross section for thermal neutrons (about 5000 barn) and because of its chemical inertness. The advantages and problems of a ^{3}He control system are illustrated by a specific example, in which a water-moderated reactor is used as a rocket engine. The ^{3}He control system consists of 2 separate circuits, which can be operated together or separately, depending on whether an isolation valve is held open or closed. The only moving parts of the system are the valves. Reactivity is reduced by opening the feed valves of one of the circuits and admitting gas from the high-pressure supply tank. The reactor now becomes subcritical, and power decreases. Initial studies indicate that ^{3}He control is feasible for a water-moderated reactor and merits continued investigation. (BBB)

35576 NERVA: ENTERING A NEW PHASE. **Schroeder, R. W. (NASA-AEC Space Nuclear Propulsion Office, Cleveland). Astronaut. Aeronaut., 6: 42-53(May 1968).**

Development of a flight-rated nuclear engine in the Nerva program is traced and present status of the program outlined. Studies of the underlying technology to support basic-reactor concepts, reactor design and development, and non-nuclear component design and development are considered. The Nerva reactor consists of a cylindrical core made of U-loaded graphite, surrounded by an insulating shell, a Be reflector, and 12 rotatable control drums in the reflector. A shadow shield at one end of the reactor partially protects some of the engine components and the propellant in the vehicle tank from the high nuclear-radiation field. The reactor and shield are contained in the pressure vessel to which is mounted a regeneratively cooled nozzle. The various Nerva reactor models (NRX-A2, NRX-A3, NRX-A4, NRX-A5, and NRX-A6) and tests which have been conducted on them are described. Radiation effects on engine and control system components are reported. (BBB)

35577 COMPARATIVE ANALYSIS OF GAS-CORE REACTORS FOR PROPULSION OF SPACE VEHICLES. **Tumm, Guenter W. (Technische Univ., Berlin). Raumfahrtforschung, 12: 49-60(Apr.-June 1968). (In German).**

One of the most advanced nuclear propulsion systems—the gas-core nuclear rocket engine—is analyzed under consideration of nuclear, technological, and systems aspects. The two main types of gas-core engines, the "coaxial flow"-concept and the "vortex flow"-concept, are compared with each other and the solid core nuclear rocket and the nuclear pulse propulsion concept. The work is divided in three parts. The first one gives a detailed nuclear analysis of gas-core reactors, the second is concerned with gas-core engine performance calculations for both concepts, and the third part deals with systems and cost studies of all considered propulsion systems. (auth)

Process Heat and Desalination Reactors

35578 DESALTING PLANT DOWN TIME PREDICTED BY FORMULA. **Arad, N. (Planning Research Corp., Washington, D. C.); Mulford, S. F.; Wilson, J. R. Environ. Sci. Technol., 2: 420-7(June 1968).**

A method for predicting down time for nuclear desalination plants is given. Factors taken into account are: flow of tubeside brine into distillate steam, calculation for yearly tube failure, and frequency of outage for plugging. An overall availability summary is tabulated; availability factors are discussed. An estimate of outage time for plugging is given; spare pump systems are recommended and requirements listed. 18 references. (M.L.S.)

35579 DESALINATION: POWER PLANT PROVES ECONOMICALLY FEASIBLE. **Bush, P. D.; Finke, J.; Wilson, J. R. (Kaiser Engineers, Oakland, Calif.). Environ. Sci. Technol., 2: 428-34(June 1968).**

The characteristics of a 100 mgd desalting plant are tabulated; estimated capital costs are listed for a 1965 cost base. Estimated unit water costs at plant boundary are given. Effects of capital and annual cost variants on the unit cost of water are tabulated. (M.L.S.)

35580 ECONOMICS OF DESALINATION. **Solov'ev, G. M. At. Energ. (USSR), 24: 123-8(Feb. 1968). (In Russian).**

Methods for the determination of the total cost in the production of electrical energy and distillation in a dual-purpose atomic desalination installation are explained. The engineering-economic comparison is given of the different distillation plans of the desalination installation: the multistage instantaneous evaporation scheme and the multiple evaporator scheme in the area of specific reduced input of the heat of the heated steam from 0.5 to 2.5 rubles for 1 gcal. It is shown that at high heat (more than 2.5 rubles for 1 gcal) the more perferable is the distillation scheme, operating by the instantaneous evaporation scheme, in which the more effective use of the heat of the heated steam because of the reduction of the number of stages is obtained easier than in vertical evaporating apparatus where the reduction of the number of evaporators is accompanied by great difficulties. At very low value of the heat (less than 0.5 rubles for 1 gcal) the more preferable is the multiple (4 to 5) evaporator installation. It is emphasized the obtention of such inexpensive heat of the heated steam from nuclear energy installations is possible only at very high unit heat output of the reactor. (tr-auth)

35581 NUCLEAR PROPULSION FOR AIRCRAFT. **Wild, John M. (General Dynamics/Convair Div., San Diego, Calif.). Astronaut. Aeronaut., 6: 24-30(Mar. 1968).**

Advances in nuclear-powered aircraft design are reviewed. Modest advances in reactor-power density and shielding technology, combined with aerodynamic, propulsion, and weight improvements, have made possible the realistic application of a unit shield to the reactor. This permits free access at all times to all areas in and around the airplane, even to the point where a man can safely stand on the shield itself when the reactor is operating at full power. A generalized payload-to-gross weight relation for unit-shielded nuclear-powered aircraft is shown. Nuclear safety aspects are discussed. More data are required on the release of fission products and their probable distribution from damaged aircraft-type reactors, and under the conditions likely to be found in aircraft propulsion. These data and the accident probability will define the radiation-hazards problem. Full containment of fission products, even in the event of a major airplane crash appears possible. However, one area where a major technological advance is required is that relating to crash containment. Even here, however, a clear course of action leading to feasibility demonstration is now visible. The He-cooled closed-cycle system appears most attractive at this time. At ranges above 4000 to 5000 nautical mi, the large nuclear airplane could carry a larger payload than a chemically powered airplane at the same takeoff weight. This is equally valid for both current and anticipated 1985 technologies. At 10,000-mi range or above, the nuclear airplane has unmatchable payload performance. Bigness carries a substantial advantage in favor of nuclear power. (BBB)

35582 USE OF NUCLEAR ENERGY FOR SEA-WATER DESALINATION. **Schwarz, K. (Zentralinstitut fuer Kernforschung, Dresden). Kernenergie, 11: 97-106(Apr. 1968). (In German).**

Discussion includes: water requirement, water quality, and the possibility of covering the requirements; methods of seawater desalination; problems of heat transfer in the evaporators; plants in operation; the use of nuclear energy for seawater desalination; designs of nuclear seawater desalination plants; and one- and two-purpose plants. (auth)

35583 COST, QUALITY, AND QUANTITY RELATIONSHIP FOR MODERN AND FUTURE DESALINATION PLANT. **Swiss, M. Water Waste Treat., 11: 544-5(Mar.-Apr. 1968).**

Economic and technological aspects of desalination, particularly by the use of nuclear energy, are discussed. It was concluded that the multi-stage flash method is most successful technically and economically, and that no competitor is likely to emerge for a decade. (BBB)

35584 QUESTIONS OF SEA WATER DESALINATION PLANT DESIGN. **Fichtner, W. (Consulting Engineer, Stuttgart). Desalination, 3: 252-8(1967).**

Economic considerations of nuclear and fossil-fuel powered sea water desalination plants are compared. These considerations refer to back pressure plants where the steam throughput of the turbines is defined by the heat consumption of the water plant. The electric power is thus a function of the specific heat consumption of the desalination process and the specific heat consumption of electric power generation. Dual-purpose plants with light water reactors and those with high pressure thermal power stations have different ranges with regard to the current yield (assuming pure back-pressure operation). The limitation of the back-pressure plant is at a higher specific heat consumption of desalination with nuclear power than with a fossil fuel power station. It is not always practical to make the specific heat consumption of the desalination plant low. The tendency of the current output figure to reach the lowest water price depends on the income obtainable from the current. All other conditions being equal, the nuclear power station reaches 60% of the current output of the fossil fuel power station in the case of pure back-pressure operation. (BBB)

35585 THE NUCLEAR DESALINATION PROGRAM AT THE OAK RIDGE NATIONAL LABORATORY. **Hammond, R. Philip (Oak Ridge National Lab., Tenn.). Desalination, 3: 243-51(1967).**

The history, function, and research results of the ORNL Nuclear Desalination Program are reviewed. The Program was established under an agreement between the Office of Saline Water (OSW) and the Atomic Energy Commission, and serves both agencies as a technical lab for desalination studies, development, and engineering. Work supported by the AEC consists primarily of technical evaluation of various types of reactors for desalting applications, developing conceptual designs of reactors specifically for desalting plants, and developing components, systems, and technology for large-scale and prototype reactors optimized for seawater conversion plants. For the OSW, functions are mostly concentrated on one portion of the overall OSW program — the development of evaporators. The program consists of 4 major categories of effort: design studies and evaluations, experimental development of advanced evaporators, component development, and assistance to the OSW staff. In a reactor extrapolation study, which is described, proponents of 4 reactor types investigated the feasibility of scaling up reactor designs to a 10,000 MW(t) rating. (BBB)

35586 COMBINATION NUCLEAR POWER AND DESALTING PLANTS. Comtois, W. H. Nav. Eng. J., 80: 90-4(Feb. 1968).

Optimization and economic aspects of nuclear-powered combination electricity-generating and water-desalting plants are examined. Economic characteristic curves of water cost (¢/1000 gal) vs power credit (mill/kWh) for 4 combination plants, each generating 500 MW(e) net are shown. Slope of the curves steepen as the product ratio increases. The curves have a common point of intersection, a feature observed for every power level studied. Also, the point of optimization is always to the left of the intersection, the power credit being fixed for a given power level. The range of optimum water costs was relatively narrow (±15% of the average) over the range of power and water capacities studied for a given fixed-charge and load factor. Also plotted are the curves for 5 plants all having a water-production capacity of 30 million gpd but with electric-generating capacity ranging from 100 to 800 MW(e) net. The slopes of the curves become steeper as the product ratio increases. The result is that, for a unit increase in electric-power credit, the greatest reduction in water cost occurs in the plant having the largest product ratio. The fixed-annual-charge rate exerts the greatest single influence on water cost, increasing the cost by about ⅔ for a factor of 2 increase in the rate. This effect is moderated somewhat for large plant sizes. Plant load factor gives the expected result of decreasing product costs with increasing load factor. The effect is a 1 to 2% decrease (increase) for every percent increase (decrease) in load factor in the range from 75 to 95%. Plant design life is of little consequence in the range normally considered (30 to 40 yr). The range of maximum brine temperatures studied was 200 to 250°F. Without exception, the computed optimum brine temperature was 250°F. The single-shaft cycles (back pressure or extraction) offer a small (5 to 10%) water cost advantage over the multishaft cycle. (BBB)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 33685, 35199, and 35207.

35587 (AD-663921) FUEL PLATE TEMPERATURE STUDIES AT THE AIR FORCE NUCLEAR ENGINEERING TEST FACILITY. Buoni, Frederick B. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). July 5, 1967. 91p. (AFIT-TR-67-9). CFSTI.

Fuel element temperatures are measured and the data are analyzed to determine the limiting power of the AF-NETF due to these fuel temperatures. The limits are 15 megawatts from loss of flow accident conditions, 20 megawatts from loss of power accident conditions and 25 megawatts from steady state considerations alone. (auth)

35588 (AD-663923) PRIMARY COOLANT CONDUCTIVITY STUDY. Baker, J. W.; Fasano, A. N.; Hary, L. B.; Buoni, F. B. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). June 19, 1967. 16p. (AFIT-TR-67-8). CFSTI.

The AF NETF, a 10 MW water-cooled research reactor, monitors the conductivity of its coolant to detect erosion/corrosion of its structural systems and fuel element failure. When a gradual increase in this conductivity sent it above the defined limit, a study was initiated to identify the contaminants and examine the source and removal processes. The major contaminant, ^{23}Na was traced to an in-leakage from the secondary to the primary coolant systems through the heat exchanger interface. Minor amounts of contaminant were introduced from a deluge tank and from residual ions remaining on the demineralizer from the factory NaOH flush. The study proved the absence of any fuel cladding defect and the presence of only an acceptably minimal structural erosion/corrosion rate. The in-leakage source was identified and corrected. The demineralizer system was found to be adequate for normal operation, but economically restrictive during the latter portion of resin life. (USGRDR)

35589 (BNWL-562) FFTF IN-LINE INSTRUMENTATION FOR SODIUM PURITY MEASUREMENT. Status Report. Demmitt, T. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1967. Contract AT(45-1)-1830. 24p. Dep. CFSTI.

The status of development work on in-line meters for measuring impurities in Na is discussed. The meters are discussed in terms of their potential for useful service in the Fast Test Reactor (FTR). The plugging meter, the electrochemical O_2 meter, the C diffusion meter, and the H_2 diffusion meter are devices that should be developed in time for use in FTR during startup operations. The electrical resistivity meter may also find useful application at FTR if efforts to improve performance characteristics are successful. No other meters appear to have sufficient merit at present to warrant use in the FTR. (auth)

35590 (BNWL-729) FFTF PRIMARY PUMP LOCATION. Johnson, H. G.; Gunby, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 51p. Dep. CFSTI.

A study was completed of the effects of locating FFTF primary pumps in either the hot or cold leg. Main considerations in the study were system costs, system thermal transients, pump reliability, and plant safety. At the current stage of conceptual design, it was concluded that hot leg and cold leg pump locations are both practical; plant capital costs are about $1 million less expensive for the cold leg location, assuming equal emergency cooling costs; operating experience at other sodium-cooled reactor plants indicates a high probability of success for pump operation at FFTF cold leg temperatures; and safety considerations and thermal transients do not lead to a preference of pump location at this time. (auth)

35591 (BNWL-SA-1863) CONTAINMENT SYSTEMS EXPERIMENT. Batch, J. M.; Rogers, G. J.; Hilliard, R. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 14, 1968. Contract AT(45-1)-1830. 38p. (CONF-680514-1). Dep. CFSTI.

From 2nd American Institute of Chemical Engineers Meeting, Tampa, Fla.

Description of the Containment Systems Experiment (CSE) is presented. Experimental facilites are described and test descriptions are included. Results of the experimental program are presented. (D.C.C.)

35592 (CNAEM-47) REACTOR PHYSICS PARAMETER (ρ^{28}) MEASUREMENTS IN THE SLIGHTLY ENRICHED WATER MODERATED LATTICES AND ITS RELATION WITH INITIAL CONVERSION RATIO. Ertek, Cetin (Cekmece Nuclear Research Center, Istanbul (Turkey)). [1966]. 139p. Dep.

Thesis. Submitted to Istanbul Univ., Turkey.

Measurements related to reactor physics parameter were made in two light water lattices. The two lattices studied consisted of 0.6-inch-diameter, 1.43% enriched U fuel rods arranged in triangular arrays with water to U ratios, 2 : 1 and 3 : 1. The following quantity is measured in each of the two lattices studied: ratio of epicadmium ^{238}U capture rate in the fuel rod to subcadmium ^{238}U capture rate in the fuel rod (ρ^{28}). In order to measure this parameter, several techniques are developed including a new chemical separation and the results are compared with the other existing methods. The experimental results are compared with theoretical results obtained from the computer programs of R. L. Hellens and H. C. Honeck of Brookhaven National Laboratory for the same lattices. (auth)

35593 (EURAEC-1882) RESULTATS D'EXPERIENCES SOUS-CRITIQUES REALISEES SUR DES RESAUX H_2O-UO_2 ENRICHIS A 5 PERCENT. (Results of Subcritical Experiments Carried Out on 5 Percent Enriched H_2O-UO_2 Lattices). Debrue, J.; Mewissen, L.; Motte, F. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)); Basselier, J.; Delrue, R.; Fossoul, E.; Haubert, N.; Lamotte, H.; Stievenart, M.; Van Deyck, D. (Societe Belge pour l'Industrie Nucleaire, Brussels). July 17, 1967. 199p. (In French). (EUR-3378). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

The results of all the different types of measurements carried out on subcritical assemblies using UO_2 with a 5% ^{235}U enrichment in the THETIS reactor at the Centre d'Étude de l'Energie Nucléaire (CEN) at Mol are presented. The lattices studied were of the square pitch type and the H_2O/UO_2 ratio had successively the five following values: 1.51, 2.63, 4.13, 6.33 and 9.35. The maximum number of fuel elements available was 500, these having a useful length of 376.5 mm and a useful diameter of 7.6 mm. The cladding is steel (304) with a thickness of 0.2 mm. The following measuring techniques were used: the Inverse Multiplication Technique (IMT), the Source Ejection Technique (SET) and the Pulsed Neutrons Technique (PNT). A certain number of measurement results were selected in order to interpret the variation in the characteristics of the assemblies as a function of a determined variable (charging, "buckling," poisoning, etc.). (auth)

35594 (EURAEC-1882(Annex)) RESULTATS D'EXPERIENCES SOUS-CRITIQUES REALISEES SUR DES RESAUX H_2O–UO_2 ENRICHIS A 5 PERCENT. (Results of Subcritical Experiments Carried Out on 5 Percent Enriched H_2O–UO_2 Lattices). Debrue, J.; Mewissen, L.; Motte, F. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)); Basselier, J.; Delrue, R.; Fossoul, E.; Naubert, N.; Lamotte, H.; Stievenart, M.; Van Deyck, D. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1967. 133p. (In French). (EUR-3378(Annex)). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Results of physics measurements carried out on subcritical assemblies using UO_2 with a 5% ^{235}U enrichment in the THETIS reactor are given. The lattices studied were of the square pitch type and the H_2O/UO_2 ratio had successively the five following values: 1.51, 2.63, 4.13, 6.33, and 9.35. The maximum number of fuel elements available was 500, these having a useful length of 376.5 mm and a useful diameter of 7.6 mm. The cladding is steel (304) with a thickness of 0.2 mm. The following measuring techniques were used: the Inverse Multiplication Technique (IMT), the Source Ejection Technique (SET), and the Pulsed Neutrons Technique (PNT). (D.C.C.)

35595 (GEAP-5576) FINAL SPECIFICATIONS FOR THE SEFOR EXPERIMENTAL PROGRAM. Noble, L. D.; Wilkinson, C. D. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 1968. Contract AT(04-3)-540. 315p. Dep. CFSTI.

The SEFOR experimental program is comprised of a series of tests beginning with low power physics tests, proceeding through static and frequency response tests at various power levels up to full power, and culminating in a series of sub-prompt and superprompt critical transients. An initial sequence of tests, detailed specifications of the number of tests, and the reactor operating conditions (such as power temperature, flow rates, and reactivity changes) for each test, as well as detailed specification of data reduction and interpretation procedures and estimated results for each of the tests are described. (auth)

35596 (IDO-17260) SPERT PROJECT QUARTERLY TECHNICAL REPORT, JANUARY–MARCH 1967. Taxelius, T. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Feb. 1968. Contract AT(10-1)-205. 57p. Dep. CFSTI.

REACTOR SAFETY EXPERIMENTS—Spert 3 E-core uranium oxide (UO_2)-fueled, description of; testing of Spert 4 Capsule Driver Core, analysis of transient

REACTIVITY—measurements of Spert 3 E-core power bursts, analysis of

REACTOR FUEL ELEMENTS—heat transfer Zircaloy-2-clad uranium oxide (UO_2)-fueled Spert 3 E-core, analysis of, (T); failures of Zircaloy-2-clad uranium oxide (UO_2) Spert 4 Capsule Driver Core, metallurgical analysis of; radiation effects on mechanical properties of PBF type 304 stainless steel-clad calcium oxide (CaO_2)–uranium oxide (UO_2)–zirconium oxide (ZrO_2), measurement of neutron, (E/T)

HEAT TRANSFER SYSTEMS—heat transfer of Spert 3 E-core, analysis of, (E/T)

URANIUM OXIDES UO_2—heat transfer in Spert 3 E-core Zircaloy-2-clad fuel elements of, analysis of, (T); radiation effects on Spert 4 Capsule Driver Core Zircaloy-2-clad fuel elements of, measurement of neutron, (E); CaO_2–UO_2–ZrO_2, radiation effects on mechanical properties of PBF type 304 stainless steel-clad fuel elements of, measurement of neutron, (E/T)

ZIRCALOY-2—heat transfer in Spert 3 E-core fuel element cladding of, analysis of, (T); radiation effects on Spert 4 Capsule Driver Core fuel element cladding of, measurement of neutron, (E)

NEUTRONS—effects on Spert 4 Capsule Driver Core Zircaloy-2-clad uranium oxide (UO_2) fuel elements, measurement of, (E); effects on mechanical properties of PBF type 304 stainless steel-clad calcium oxide (CaO_2)–uranium oxide (UO_2)–zirconium oxide (ZrO_2) fuel elements, measurement of, (E/T)

THERMOCOUPLES—calibration of, rhenium/tungsten–tungsten, description of static, (E)

TUNGSTEN COUPLES—Re/W–W, calibration of, description of static

POWER BURST FACILITY—fuel elements for, analysis of, neutron radiation effects on mechanical properties of type 304 stainless steel-clad calcium oxide (CaO_2)–uranium oxide (UO_2)–zirconium oxide (ZrO_2), (E/T)

STAINLESS STEEL—radiation effects on mechanical properties of PBF fuel element cladding of, measurement of neutron, (E/T) (D.C.C.)

35597 (INR-878/XXI/PR) CALCULATIONS OF THE WWR-SM LATTICES. Kowalska, Krystyna (Institute of Nuclear Research, Warsaw (Poland)). 1968. 83p. Dep.

Descriptions of the methods used for the micro- and macroscopic calculations of the experimental cores on the WWR-SM critical assembly MARYLA-2 are presented. Comparisons of the computed parameters and neutron flux distributions with the experimental results are described. Discussion of the applicability of the theoretical models and the developed system of reactor codes is included. (auth)

35598 (INR-879/XI/R) CLADDING TEMPERATURE MEASUREMENTS OF THE EK-10 TYPE REACTOR FUEL RODS IN EWA-2 CORE. Aleksandrowicz, J.; Czerniewski, M.; Labno, L. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 46p. Dep.

A program of EK-10 type fuel rods temperature measurements was performed in the EWA reactor by steady state and transient conditions. Temperature transients were measured during flow failure type-test and by tests initiated by ramp reactivity addition. (auth)

35599 (K-D-2006) EFFECT OF STEEL-WATER REFLECTORS ON THE CRITICALITY OF LOW-ENRICHED URANYL FLUORIDE SOLUTION. Johnson, E. B. (Oak Ridge National Lab., Tenn.); Newlon, C. E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1967]. Contract W-7405-eng-26. 8p. (CONF-680601-16). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

The effect of composite reflectors of steel and water on the reactivity of single cylinders of aqueous solution of low-enriched UO_2F_2 is described. The results are applicable to evaluation of criticality safety of shipping containers and for verification of calculational models. (D.C.C.)

35600 (LA-3832) THERMAL IRRADIATION OF LIQUID PLUTONIUM-ALLOY FUELS. Cubitt, R. L.; Ragan, G. L.; Kirkpatrick, D. C. (Los Alamos Scientific Lab., N. Mex.). Sept. 1967. 20p. Dep. CFSTI.

In-pile test loops for irradiating liquid plutonium-alloy fuels were operated in the Omega West Reactor. These loops provided a sodium environment for test fuel capsules at temperatures similar to those expected for liquid-metal-cooled fast breeder reactors. Eleven fuel capsules were irradiated with up to 2.6 at.% burnup of plutonium. The design, construction, and operation of the irradiation loops and the handling of the irradiated test fuel capsules are described. (auth)

35601 (N-68-10133) SHIELDING REQUIREMENTS FOR THE NASA PLUM BROOK HB-6 BEAMHOLE RADIATION EFFECTS FACILITY. Bloomfield, Harvey S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov. 1967. 23p. (NASA-TM-X-1461). CFSTI.

The calculational methods and results used to design a shield assembly for the Plum Brook Reactor HB-6 beamhole facility are described. The function of this shield assembly is to provide adequate biological protection during reactor operation and to permit personnel access to a test chamber after shutdown. Radiation sources examined during reactor operation were neutrons and gamma rays scattered by an experimental package in the test chamber, direct core radiations, and radiation through rectangular slits which may be formed by misalignment of shield sections. Fission product decay gammas and neutron-induced gamma activity in the test chamber were the important radiation sources investigated after shutdown. The bulk of the calculations was performed by specialized digital computer shielding programs which accounted for considerable detail of the core-beamhole geometry. Calculational results compare favorably with experimental measurements on the final shield assembly. (auth)

35602 (N-68-10291) COMPARISON OF ABSOLUTE CALCULATED AND MEASURED GAMMA AND NEUTRON DOSES IN TUNGSTEN-WATER-MODERATED CRITICAL ASSEMBLY. Klann, Paul G.; Paulson, Walter A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov. 1967. 55p. (NASA-TN-D-4223). CFSTI.

The mixed γ and neutron dose was measured at 60 locations within the Tungsten–Water-Moderated Reactor critical assembly. Graphite wall thimble ionization chambers filled with CO_2 and polyethylene wall chambers filled with ethylene were used. The chambers were absolutely calibrated in a bremsstrahlung beam against a secondary calibration standard and in a reactor against a water filled calorimeter. These calibrations were used to obtain γ and neutron response coefficients for the chambers which permitted partitioning of the measured mixed radiation dose into a γ dose and a neutron dose. The measured γ doses were compared with an Athena Monte Carlo calculation. Good agreement was found for the 16 locations compared. The average deviation was 10%. In addition, the measured neutron doses were compared with a "first collision" calculation of the dose. The calculated neutron doses were uniformly low with an average deviation from the measurement of 18%. (auth)

35603 (ORNL–4242) FABRICATION PROCEDURES FOR MANUFACTURING HIGH FLUX ISOTOPE REACTOR FUEL ELEMENTS. Knight, R. W.; Binns, J.; Adamson, G. M. Jr. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 180p. Dep. CFSTI.

A production procedure was developed for manufacturing High Flux Isotope Reactor fuel assemblies. The entire fuel assembly of this reactor is made up of two fuel elements, each element consisting of an annular array of fuel plates. These annuli are identified as the inner and outer fuel elements. The inner element consists of 171 identical fuel plates and the outer element consists of 369 identical fuel plates differing slightly from those in the inner element. Both sets of fuel plates contain U_3O_8 powder as the fuel dispersed in an Al powder matrix and clad with Al. Procedures for manufacture and inspection of the element are described and illustrated. The procedures described have been used to manufacture 46 fuel assemblies for operation at 100,000 kW. No fuel element has been rejected, but no fuel element has been manufactured that meets all of the specification requirements. The deviations that have been accepted are not serious enough to affect the reactor operation. Fuel-plate recovery for 25,000 fuel plates has been 90%, with the largest losses occurring in blistered plates and surface damage. (auth)

35604 (ORNL–4253) REMOVAL OF IODINE VAPOR FROM AIR AND STEAM-AIR ATMOSPHERES IN THE NUCLEAR SAFETY PILOT PLANT BY USE OF SPRAYS. Parsly, L. F.; Franzreb, J. K. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

The results of a series of nine experiments in which I_2 vapor was released into the model containment vessel of the Nuclear Safety Pilot Plant and then removed by sprays are presented. The experiments show that a half-life for iodine vapor removal of less than 1 min can be achieved using a type of nozzle proposed for installation in power reactor containment buildings at liquid mass flows currently being proposed. Thus they show that spray systems can be designed which are capable of removing iodine from containment building atmospheres rapidly enough to make a significant reduction in the 2-hr dose due to iodine leakage. Little effect of solution composition on spray performance was found; condensation of steam on the drops also had no significant effect. Fair agreement was found between the experimental results and a proposed analytical model. (auth)

35605 (ORNL–4263) CRITICAL EXPERIMENTS FOR THE REPETITIVELY PULSED REACTOR SORA. Kistner, G.; Mihalczo, J. T. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 105p. Dep. CFSTI.

A series of static critical experiments has been performed on an accurate mock-up of the SORA Reactor. SORA is a NaK-cooled repetitively pulsed fast reactor which will be used as a high intensity neutron source for time-of-flight experiments. The reactivity of this reactor is varied by a movable reflector. Those parameters which are related to the kinetics of the reactor have been investigated thoroughly in the critical experiments. They have been measured for beryllium and for iron reflectors of several sizes and for various core and fixed reflector configurations. The total reactivity of the movable reflectors varied from 3.7 dollars for a 11-cm-wide iron reflector to 12 dollars for a 26.2-cm-wide beryllium reflector. The reactivity of the movable reflector as a function of its position has been shown to have a parabolic dependence on position characterized by the parameter α_x which varied from 4 to 9.9 cents/cm^2. The prompt neutron time decay is described by a fast decay constant which varied between 0.30 and 0.55 μsec^{-1} and a slow decay constant which varied between 0.05 and 0.10 μsec^{-1}. The critical masses for the various experiments was between 50.3 to 57.3 kilograms of uranium enriched to 93.2 wt % ^{235}U. Using space independent neutron kinetics with one delayed neutron group, it has been shown that with a 24-cm-high, 7-cm-thick, 21-cm-wide beryllium reflector the assembly will produce pulses approximately 50 μsec wide at half maximum power with a peak-to-minimum power ratio of approximately 4000. (auth)

35606 (ORNL-TM–2196) HFIR FUEL ELEMENT PRODUCTION AND OPERATION. Adamson, G. M. Jr.; Knight, R. W. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

The High Flux Isotope Reactor has been in operation for over two years and at full power for one and one-half years with no fuel element problems – the satisfactory performance being indicated by both the reactor operation and the hot-cell examination of a burned element. Areas in the fuel plates with burnups estimated as high as 18.6×10^{20} fissions/cm^3 showed no significant irradiation damage. Gamma scans of the plates confirmed that the desired flux profiles had been obtained. Data are presented showing that these complex HFIR fuel elements can be produced commercially with the excellent recovery rate of 88.2% for a total of over 30,000 plates. The major causes of plate rejection were surface defects and nonbonds. Excellent control was achieved of the cladding thickness, fuel core dimensions, and water-channel spacing. While 45 fuel assemblies have been delivered and all have been accepted for full-power use, only four inner elements have not required minor waivers of some kind. The waivers arose from a variety of causes. There is no requirement in the specifications that is unattainable, and with a few minor exceptions no problems have occurred with sufficient frequency to require a change in the specifications. (auth)

35607 (ORNL-TM–2207) EXCURSION AT THE OAK RIDGE CRITICAL EXPERIMENTS FACILITY, JANUARY 30, 1968. Callihan, Dixon (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 13p. Dep. CFSTI.

A volume of an aqueous solution of $UO_2(NO_3)_2$, in which the ^{233}U content of the U was 97.6%, was inadvertently made super prompt critical in the Oak Ridge Critical Experiments Facility. The fission yield was 1.1×10^{16}. There was neither internal nor external measurable exposure of any individual to radiation; there was no property damage or material loss. Fission products decayed sufficiently within twenty-four hours to allow unrestricted occupancy of the affected room. Solution containing an estimated 15 g of U was spilled into the reflector-water tank as the result of a dislodged rubber stopper. (auth)

35608 (ORNL-TM–2237) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JANUARY–MARCH 1968. Tabor, W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). May 21, 1968. Contract W-7405-eng-26. 44p. Dep. CFSTI.

Topics discussed include: operations; maintenance and changes; fuel status; experiment facilities and lattice configuration; special tests; and corrosion test results for primary and secondary systems. (D.C.C.)

35609 INVESTIGATION OF RADIOLYTIC PRODUCTS DURING REACTOR WWR-M OPERATION WITHOUT INCLUDING DEGASIFICATION SYSTEM. Kaminker, D. M.; Konoplev, K. A.; Semenov, Yu. P.; Trenin, V. D. At. Energ. (USSR), 24: 343-8(Apr. 1968). (In Russian).

The results of the investigation of the radiolytic products in the reactor WWR-M primary cooling system during reactor operation without degasification system are described. It was shown that the concentration of the radiolytic products — hydrogen and hydrogen peroxide dissolved in water depends on reactor power unlinearly and if the power is over 8 MW the concentration does not change. The results of investigation showed the feasibility of the safety operation of the reactor WWR-M and of the same type reactors without including degasification system. 9 references. (auth)

35610 RESEARCH AND TEST REACTOR OF THE PHYSICAL-TECHNICAL FEDERAL INSTITUTE. Wagner, S. PTB Mitt., 78: 3-5(Feb. 1968). (In German).

A detailed description of the research and test reactor is given; thermal flux characteristics are shown as a function of position. Descriptions are given of: the reactor core, pool, cooling system and water circuits, control and instrumentation, bridge room and installation floor, and experimental facilities. (M.L.S.)

35611 IRRADIATION POTENTIAL IN THE REACTOR. Viehl, E. PTB Mitt., 78: 14-16(Feb. 1968). (In German).

Neutron flux profiles and reactivity worths of the Physikalish-Technischen Bundesanstalt (PTB) research reactor test facilities are tabulated. Descriptions of the pneumatic rabbit, thermal column, and beam holes are given. (M.L.S.)

35612 NUCLEAR ENERGY RESEARCH CENTRE AT MOL. Goens, J. Nature (London), 218: 831-3(June 1, 1968).

Applied research was the main purpose of the Nuclear Energy Research Center at Mol, Belgium, when it was established in 1952, but present work includes solid state and theoretical physics, radiobiology and genetics. (auth)

35613 SOME SAFETY ASPECTS OF THE KSTR (KEMA SUSPENSION TEST REACTOR). **Wijker, H.** (KEMA, Arnhem, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 27, 53-70 (1968). (In Dutch).

The reactivity of the reactor can be reduced by dumping of suspension or suspended particles in a dump vessel and by the negative temperature coefficient of the system. Connections in the reactor vessel and its pipes are made by flanges, which are surrounded by a chamber filled with clean water under high pressure. Values of air pressure in the vessel compartments and in the reactor building that may occur upon breakage of the reactor are estimated and their consequences for the construction of the structures discussed. (J.J.t B.)

35614 SEIBERSDORF REACTOR AND RESEARCH CENTRE. **Higatsberger, Michael J.** (Oesterreichische Studiengesellschaft fuer Atomenergie, GmbH, Seibersdorf, Austria). Nature (London), 218: 852-4(June 1, 1968).

For twelve years, industry and the universities have jointly been running the national atomic energy organization at Seibersdorf, Austria, the work of which is described. (auth)

35615 INVESTIGATION OF PuO_2 FUEL ELEMENT ASSEMBLY OF BR-5 REACTOR. **Kazachkovskii, O. D.; Votinov, S. N.; Lebedev, I. G.; (and others).** At. Energ. (USSR), 24: 136-43(Feb 1968). (In Russian).

The results of the investigation of PuO_2 fuel elements of the BR-5 reactor after 6.1 wt % burnup are reported. It is shown that the assembly and the heat emitting elements, except for one central element, were found in a satisfactory condition. A diameter increase up to 2% was detected. By measurement of the total gas, emitted under the fuel cladding, it was established that 80% of the gaseous products formed during fission are given off from the fuel during 6.1 wt % burnup and temperature in the center of 1500°C. By x-ray methods it was established that PuO_2 in the damaged fuel had become amorphous; after annealing at 1000°C the structure was restored. Data on the stability and comparative elongation of steel 1X18H9T from the fuel cladding at 20, 350, 500, and 650°C and on the microhardness were reported. On the basis of the analysis of the operating conditions, stress state, properties of the fuel material, and fuel jacket, conclusions are made on the reason for the destruction of the one fuel element. (tr-auth)

35616 METHOD FOR IRRADIATING SAMPLES WITH THERMAL NEUTRONS IN THE D_2O-MODERATED REACTOR CORE. **Nakai, Yasushi** (to Japan Atomic Energy Research Inst.). **Japanese Patent 1967-24624. Nov. 27, 1967. Filed May 27, 1963.**

By the method proposed, a sample in the capsule can be highly irradiated effectively without reducing the (reactor) reactivity; this is achieved by specially increasing the neutron flux in the capsule. In irradiating a sample contained in the capsule in the core heavy water, the capsule is filled with light water. (NSA of Japan)

35617 POLISH HIGH-FLUX RESEARCH REACTOR R-II. DESIGN CRITERIA AND FUNCTIONAL DESCRIPTION. **Berens, Tadeusz** (Inst. of Nuclear Research, Swierk, Poland); **Dabrowski, Cyryl; Latyszew, Mikolaj; Nycz, Czeslaw; Belowski, Tadeusz; Brzeski, Jan; Grabowski, Ryszard; Jozwik, Boleslaw; Tylman, Tadeusz.** Nukleonika, 13: 337-48(1968).

Criteria followed by designers of the Polish High-Flux Research Reactor in choosing the type and in designing the reactor system are presented. The construction of the reactor and the reactor building are described, and the main performance parameters are listed. (auth)

35618 EXPERIMENTAL STUDY ON SUBCRITICAL ASSEMBLY WITH NEUTRON SOURCE. **Miyawaki, Yoshio** (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 5: 222-8(May 1968).

A new definition of subcritical constants is introduced on the basis of the neutron balance equation. These subcritical constants are obtained by integrating the intensity of the neutron flux over the whole volume of the subcritical assembly with neutron source. Some other constants commonly used in conventional reactor physics can be predicted by analyzing the above mentioned subcritical constants. As examples of applications of this method, the infinite medium multiplication factor for natural uranium-light water system and the critical buckling for 20% enriched uranium-light water system have been determined experimentally with the use respectively of Ra-Be and spontaneous fission neutrons as the neutron source. The experimental results obtained are in comparatively good agreement with the values from exponential experiment and with theoretical values calculated by a four-factor formula. (auth)

35619 EXPERIMENTAL VESSEL-TYPE REACTOR AND SOME DATA ON THE REACTOR START-UP. **Sokolov, I. N.; Kramerov, A. Ya.; Kulikov, E. V.; Solov'ev, Yu. A.; Gritskov, V. I.; Shmelev, V. E.** Teploenergetika, No, 5, 62-7(May 1968). (In Russian).

A brief review is given of the thermal scheme and construction of an experimental reactor. Some data on start-up are included. The use of natural circulation for cooling nuclear reactor fuel elements is stressed. (tr-auth)

35620 INCREASING THE POWER OF FiR 1. **Vaurio, Jussi.** Tek. Aikak., No. 4B, 25-31(1968). (In Finnish).

Both research and isotope production at the FiR 1-reactor of type Triga Mark II at Otaniemi have continuously increased since the beginning of operation in 1962. To facilitate further development the power of the reactor was increased in August 1967 by a factor of 2.5 up to 250 kW. The maximum neutron flux now available is 10^{13} cm^{-2} s^{-1}. The problems encountered and solved in the raising of the power level are described. (auth)

35621 REACTIVITY METER OF FiR 1. **Siro, Arvo.** Tek. Aikak., No. 4B, 18-20(1968). (In Finnish).

A reactivity meter has been built for the TRIGA reactor at Otaniemi. It has been designed for use in both reactivity calibrations and control of the reactor. The meter consists of an analogue computer that solves the reactivity from a voltage signal proportional to the power. The analysis is based on a simple kinetic model for the neutron flux, i.e., the one group treatment of a point reactor. The usefulness of the reactivity meter has been demonstrated in practice. The kinetic model used does not noticeably impair the results, if its limitations are taken into account in the setting up of the instrument. The accuracy is then 3 to 4%. (auth)

35622 TECHNIQUES FOR DETERMINING THE NUCLEAR CHARACTERISTICS OF THE SODIUM-COOLED LOOP USED IN BR2 TO TEST FAST-REACTOR FUELS. **Debrue, J.; De Coster, M.; De Raedt, Ch.; Fabry, A.** (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 413-32 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A loop for testing fast-reactor fuels was designed and installed in the BR2 high-flux reactor. The fuel pins are cooled with sodium, which permits the removal of 130 kW of power. Absorbing screens (B, C, and Cd) round the section of the loop inside the reactor stop the low-energy components of the incident neutron spectrum. The intensity and energy distribution of the neutron flux is capable of producing a high mean power density in the test fuel without excessive flux depression, even with high fissionable-material contents. Irradiation conditions in BR2 are based on measurements made in the BRO2 reactor, the nuclear model of BR2. These values are used in conjunction with calculations made with diffusion and transport (DS_n method) codes. Special indices and fission rates are used to check the correctness of the calculated spectrum and the constants used for the fissionable materials. The main problems consist of relating the power density in the fuel pins, as measured in BRO2, with the total power of BR2, using this power density value to calibrate the in-loop integrating flux meters, and determining changes in these parameters during irradiation. The problems involved in applying the combined set of measuring and calculating techniques are discussed. (auth)

35623 ANALYSIS OF THE TECHNIQUES FOR MEASURING THE REACTIVITY OF FAR SUB-CRITICAL MULTIPLYING SYSTEMS. **Vandeplas, P.** (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 493-512 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The methods of measuring control-rod worth on the basis of reactor response to a periodic excitation source are analysed, and it is shown that the ratio of the integrals of the prompt and delayed neutron densities over one period is independent of the shape of the signal used. This ratio will thus be equal to the ratio of the neutron densities in the presence of a time-independent source. The pulsed source, sinusoidal source and source removed methods therefore give identical worth values. Experimentation and numerical analysis show that the ratio of prompt to delayed neutron density, which is a linear combination of successive eigenvalues of the system, is largely dependent on the position of the source. (auth)

35624 GENERATION OF INTERMEDIATE STANDARD NEUTRON SPECTRA AND THEIR APPLICATION IN FAST REACTOR

PHYSICS. Fabry, A.; Vandeplas, P. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 389-411 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The possibility of generating intermediate standard neutron spectra through partial moderation of the uranium-235 thermal fission spectrum within a cavity in a conventional thermal column has been investigated. Multigroup transport calculations on simple spherical arrangements of source and moderator have shown that a family of well-predictable neutron spectra can be produced and that fast reactor spectra are sufficiently well simulated, in the useful energy range. A highly flexible mock-up of such a system has been realized in a spherical cavity hollowed out of the protruding end of the graphite thermal column of the BR1 reactor. Preliminary measurements by the activation technique are compared with theory. It is shown that the device can be used as a tool for better assessment of neutron spectrometry techniques and for accurate integral testing of basic nuclear data. (auth)

35625 FRENCH FAST REACTOR PHYSICS PROGRAMME. Storrer, F.; Tretiakoff, O.; Vendryes, G. (Associated Euratom-CEA, Cadarache, France). pp 27-35 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The work done by the Euratom-CEA Association in the field of fast reactor physics is presented. Although RAPSODIE was not designed as a tool to be used in reactor physics, neutron measurements made with this reactor since it first went critical have provided data on fast reactor physics in general and on the operation of this reactor. RAPSODIE has completed the equivalent of 70 operational days at the rated power of 20 MW(th); burn-up in the reactor core has now reached 9000 MWd/t. Particular attention is being given to the problem of critical mass and to reactivity build-up. Neutron studies in preparation for PHENIX, begun over two years ago, are described. Use of the MASURCA critical assembly, the HARMONIE reactor, and the ERMINE fast-thermal critical assembly mounted within the MINERVE swimming-pool reactor is described. (auth)

35626 ENERGY- AND TEMPERATURE-DEPENDENT CAPTURE MEASUREMENTS BELOW 30 keV SUPPORTING DOPPLER EFFECT CALCULATIONS. Seufert, H.; Stegemann, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp 77-94 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (EURFNR-400).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Energy- and temperature-dependent capture measurements below 30-keV neutron energy were performed in natural uranium, tungsten, and tantalum using the slowing-down time spectrometer technique. The experimental set-up used for the experiments consists of a lead block of 1.3 m side length containing two experimental channels of 10 × 10 cm^2 cross-section. Into the first channel the target of a 14-MeV neutron generator is introduced, whereas the second channel is used for insertion of the heated samples. Pulses of 14-MeV neutrons, having a pulse width of about 1 μs, are used. The neutron energy is degraded first by inelastic collisions; afterwards only elastic collisions take place so that a specific relationship holds between mean neutron energy in the lead pile and the time after occurrence of the neutron pulse Because of this time-energy relation a time analysis procedure for the detector counts is applied. Because the energy range below 30-keV neutron energy is most interesting for Doppler-effect investigations the slowing-down time spectrometer is used to measure the capture ratios of hot-to-cold samples of natural uranium, tungsten, and tantalum. Thin samples were heated to different temperatures for this purpose, and the capture γ-rays were detected by proportional counters. Because hot-to-cold capture ratios are measured a knowledge of the neutron flux is not necessary; therefore, a direct comparison of calculated and measured temperature-dependent cross-sections is possible. A theoretical analysis of the experimental data for uranium is given. (auth)

35627 GROUP CROSS-SECTION SET KFK-SNEAK. PREPARATION AND RESULTS. Kuesters, H.; Bachmann, H.; Huschke, H.; Kiefhaber, E.; Krieg, B.; Metzenroth, M.; Siep, I.; Wagner, K.; Woll, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp 167-88 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

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For the calculation of integral quantities, measured in the Fast Zero-Power Assembly SNEAK, a new group cross-section set was prepared directly from microscopic data. These data are based on the latest evaluation of cross-section and resonance parameters tabulated on the Karlsruhe Nuclear Data File.KEDAK. Special attention is paid to the calculation of the elastic moderation. (auth)

35628 ANALYSIS OF INTEGRAL EXPERIMENTS ON THE ZPR VI CRITICAL FACILITY. Cecchini, G.; Gandini, A. (CNEN, Rome). pp 367-76 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

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A new approach is presented to integral experiment evaluation, which correlates nuclear group parameters to the integral data. This correlation is applied to the sodium void experiments made on the ZPR VI critical facility. The basic feature of the method consists in the use of generalized perturbation techniques and in the minimization of nuclear parameter corrections. (auth)

35629 FAST-THERMAL COUPLED SYSTEM FOR INTEGRAL MEASUREMENTS OF FISSION-PRODUCT CROSS-SECTIONS. Bustraan, M. (Reactor Centrum Nederland, Petten). pp 349-66 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

In the framework of the co-operation of the West Germans, Belgians and Dutch on fast-breeder research a feasibility study has been initiated on the possibilities for integral measurements of fission-product cross sections for fast reactor systems. Uncertainties may exist regarding coolant void coefficients of 10 \$ for a Na-cooled and of 20 \$ for a steam-cooled design. Some of these uncertainties are caused by inaccuracies in cross sections for fissile and fertile isotopes, and can be reduced considerably by results from critical experiments. The remainder (up to 4 \$ for Na and up to 6 \$ for steam-cooled breeders) is mainly due to inaccuracies in cross sections of fission products. It is proposed to convert the existing, heavily shielded, light-water critical experiment KRITO at the Petten site of the Reactor Centrum Nederland into a coupled fast-thermal system, in the fast zone of which by oscillator methods integral cross sections of actual fission product mixtures, elements and nuclides, are to be measured by oscillator methods. To specify the compositions of the fast zone a number of 26 group diffusion calculations have been performed based on the ABBN set. A design has been made which can accommodate the variable fast zone sizes needed for the various spectra. The programme of the measurements is outlined. At the same time a small heavily shielded facility is being designed for chemical separation of fission product elements from reactor wastes and from ^{239}Pu and ^{235}U irradiations in the high flux reactor at Petten. In addition to the fission product cross sections, integral cross sections for other materials and even Doppler coefficients could be measured in the proposed system. (auth)

35630 ANALYSIS OF THE POSSIBILITY OF LARGE-SCALE IRRADIATION OF FAST REACTOR FUEL IN THE BR2 MATERIALS-TESTING REACTOR. Minsart, G.; Motte, F. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 327-48 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Devices used in the BR2 reactor to irradiate fuel pins Na-cooled under forced circulation, as part of a series of studies on fast reactor fuel designs, are described. The low-energy component of the neutron spectrum incident on these devices is filtered out by B and Cd screens. Attempts have been made to design an irradiation device of greater power, which would allow a fast-reactor fuel sub-assembly to be tested to high burn-up rates, under specific spectral and power conditions representative of the next generation of fast reactors. These specifications and the size of the sub-assembly preclude the idea of filtering out the incident spectrum, instead of which this spectrum has to be transformed in a zone at the periphery of the sub-assembly. A device of this type, given the name of SOCRATE, is to be placed in the central experimental cavity (diameter ≈ 200 mm) of the BR2 reactor. It would contain about 380 fuel pins of 6 mm diameter, arranged in a triangular lattice of 7.9 mm pitch and cooled by circulating Na. The 61 pins at the center of this lattice form the sub-assembly. At the enrichment adopted, the maximum specific power in the zone containing the sub-assembly is about 1 MW/l for a maximum linear power of 530 W/cm. A burn-up of 80 000 MWd/t could, in principle, be attained within a year. Comparative analysis of stresses and damage in the sub-assembly pins, as referred to the properties of the Na-2 reactor core is presented. Irradiation in SOCRATE could be a significant way of testing a fuel sub-assembly designed for a fast reactor. (auth)

35631 EXPERIMENTAL STUDY OF THE NEUTRON CHARACTERISTICS OF FAST CORES IN THE ERMINE THERMAL-FAST CRITICAL ASSEMBLY. Bouchard, J. (CEA, Fontenay-aux-Roses, France); Vidal, R.; Mougniot, J. C. pp 309-25 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A section of fast-reactor lattice was placed in the central hole of the MINERVE reactor, thus forming a coupled "thermal-fast" critical assembly. The construction of the first core, composed of the MASURCA 1-B lattice of 30% enriched uranium diluted in graphite, together with the experimental techniques used is described. Most measurements were carried out by the oscillation method, using an automatic regulating rod, to compensate for reactivity effects. The experiment was conducted with special care, so as to avoid electronic, mechanical and neutron perturbations as much as possible. The results of measurements of spectral indices and of reactivity effects of fissile, fertile and structural materials are presented. The results of experiments carried out to determine heterogeneity effects, the Doppler effect of ^{238}U and the importance functions are also presented. These experimental values are compared with values calculated from transport theory. (auth)

35632 TIME-DEPENDENT S_N CALCULATIONS DESCRIBING PULSED SOURCE EXPERIMENTS AT THE FRO REACTOR. Bergstroem, A.; Kockum, J.; Soederberg, S. (Research Inst. of National Defence, Stockholm). pp 453-65 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

In view of the difficulties in describing pulsed source experiments quantitatively in assemblies consisting of a fast core and a light reflector, a time-dependent S_N code has been applied to this type of assembly. The code, written for the IBM 7090 computer, divides time into short intervals and computes the flux in spherical geometry for each interval using the Carlson S_4 scheme. The source term is obtained by extrapolation from two earlier time-intervals. Several problems in connection with the discretization of the time, space and energy dimensions are discussed. (auth)

35633 INTERPRETATION OF REFLECTOR SAVINGS MEASURED IN WATER-MODERATED AND REFLECTED EXPONENTIAL EXPERIMENTS. Windsor, Henry H. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 33: 139-41(1968).

Computer calculations to infer the asymptotic reflector savings from measurements of radial-flux distributions in small exponential piles are presented. A method for using standard multigroup lattice calculations for this purpose is presented. The approach is applied to 7 water-moderated and reflected exponential cores fueled with elements containing 3% $^{233}UO_2$-97% ThO_2. The calculated differences between the thermal flux shape and asymptotic reflector savings are found to be as large as 4%. Application of this difference to the experimentally measured flux-shape reflector savings yielded corrected flux-shape reflector savings. (auth)

35634 THERMAL NEUTRON ENERGY SPECTRUM IN THE ELEMENTARY CELL OF THE WWR-S REACTOR. Hron, M.; Vanicek, J. (Nuclear Research Inst., Prague). Kernenergie, 11: 112-16(Apr. 1968).

The determination of the thermal neutron spectra in a heterogeneous reactor cell is described. A numerical solution of the integral transport equation using the first collision probabilities is derived. Results are presented for the equivalent cylindrical cell of the WWR-S reactor which are compared with the results of other calculations and measurements. (auth)

35635 MEASUREMENT OF REACTOR FLUCTUATION SPECTRA AND SUBCRITICAL REACTIVITY. Ricker, C. W.; Hanauer, S. H.; Mann, E. R. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 33: 56-64(1968).

Fluctuation spectra of the current from a neutron-sensitive ionization chamber located in a reactor have been determined experimentally with increased precision. The cold and clean Bulk Shielding Reactor core was held critical and at various subcritical reactivities up to $\rho = -10\beta$. The amplified current fluctuations were processed on-line in a ten-channel spectrum analyzer utilizing analog-computer components. The shapes of the spectra, and the values of neutron generation time and reactivity inferred therefrom, were in good agreement with theoretical predictions and with values measured using the pulsed-neutron technique. The results were the same for the two detector locations investigated. (auth)

35636 CENTRAL REACTIVITY CONTRIBUTIONS OF ^{244}Cm, ^{239}Pu, AND ^{235}U IN A BARE CRITICAL ASSEMBLY OF PLUTONIUM METAL. Barton, David Maxwell (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Nucl. Sci. Eng., 33: 51-5(1968). (LA-DC-9342).

Central reactivity contributions of gram-sized samples of ^{244}Cm, ^{239}Pu, and ^{235}U have been obtained in a fast critical assembly of bare ^{239}Pu in a spherical geometry. Resulting values are: ^{244}Cm = (1276 ± 5%) cents/g at.; ^{239}Pu = (1393 ± 3%) cents/g at.; ^{235}U = (701 ± 2%) cents/g at. From these data, the critical mass of a bare sphere of ^{244}Cm is estimated to be (27.7 ± 2.5) kg at a density of 13.5 g/cm^3. (auth)

35637 INVESTIGATION OF THE CRITICALITY OF LOW-ENRICHMENT URANIUM CYLINDERS. Chezem, C. G. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng., 33: 139(1968).

An attempt to achieve a near-critical assembly with a minimum average ^{235}U enrichment of an unreflected, uranium metal, 21-in.-diam cylinder has been completed. Data were required for the design of a low-enrichment, uranium metal, reflected system. Utilizing only the materials on hand, 21-in.-diameter plates of 93.3% enriched uranium and normal uranium, four low-enrichment cylinders were investigated. The thickness of the normal uranium plates dictated the exact enrichments attainable by interleaving the plates in a cyclic manner along the axis. The critical parameters were obtained by extrapolation of inverse multiplication curves, which extend to 93 to 95% of the critical height. Corrections for the reflecting properties of the vertical support structure and the building itself were applied. The significant results are tabulated. A least-squares analysis (quadratic) of the data, inverse critical height squared vs percent enrichment, yields results which extrapolate to an infinite-height enrichment of 10.5 ± 0.2%. (auth)

35638 THERMAL-NEUTRON DECAY IN SMALL SYSTEMS. Dorning, J. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 33: 65-80(1968). (BNL-11892).

The pulsed-neutron experiment discrete time-decay constants are examined in slab and spherical geometries using a one-term degenerate isotropic scattering kernel. The integral form of the space-, energy-, and time-dependent neutron-transport equation is considered in the proof of four theorems that determine the nature of the decay constants as a function of system size. The theorems are verified by actual calculation of the decay constants for the simpler of the two degenerate-kernel models considered. The spatial eigenfunctions that become flatter as system size is decreased are also computed. The one-velocity problem is solved as a special case. Pulsed-neutron experiment size-dependent extrapolation distances are defined and calculated in such a way as to bring exp (iB·r) theory decay constant results into agreement with those obtained by a more rigorous treatment of the spatial dependence, even for vanishingly small systems. Again, the monoenergetic problem is included as a special case. The variable extrapolation distances approach the Milne problem value as system size is increased. The variation of the extrapolation distance with system dimension is discussed in terms of opposing effects of the thermalization and transport phenomena. Estimates of leakage angular distributions and energy spectra in slabs are calculated from single iterations (performed analytically) in spatial functions synthesized from asymptotic solutions using the size-dependent extrapolation distances. The nature of the singularity in the angular distributions within extremely small systems is investigated. Finally, physical explanations for the changes in the leakage angular distributions and energy spectra (which are diffusion cooled) with slab dimensions are proffered. (auth)

35639 EFFECT OF MODERATOR DENSITY ON THE REACTIVITY OF THE SM-2 REACTOR. Tsykanov, V. A.; Kormushkin, Yu. P.; Zaletnykh, B. A.; Klimenkova, N. A.; Korotkov, R. I. At. Energ. (USSR), 24: 84-5(Jan. 1968). (In Russian).

Water is usually utilized as the moderator in neutron traps where part of the feul has been removed from the center of the active zone. A rise in reactivity has been observed on heating water in the central channel of the SM-2 reactor. This effect was then investigated on a model of the reactor by using special plexiglass inserts to vary the density from 1 to as low as 0.165 g/cm^3. The decrease in water density introduced a positive reactivity. The reactivity increased with decreasing density until it reached a maximum at a density of 0.45 g/cm^3. The reactivity then fell but remained positive with a further decrease in density. Maximum increases in reactivity were 3.4 and 2.4% for systems having active zone heights of 350 and 250 mm respectively. These experiments indicate the danger of an uncontrolled release of water from the neutron trap. (TTT)

35640 INVESTIGATION OF THE DOPPLER EFFECT IN ^{238}U IN THE OXIDE BLANKET OF THE BR-1 REACTOR. Abagyan, L. P.; Golubev, V. I.; Golyaev, N. D.; Zvonarev, A. V.; Koleganov, Yu. F.; Nikolaev, M. N.; Orlov, M. Yu. (Physical-Energy Inst., Obninsk, USSR). pp 317-27 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In Russian). (ANL-Trans-540).

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Studies have been carried out on the Doppler increase in capture rate in thin samples of uranium-238 irradiated in a large block of depleted UO_2 at room temperature. The core of the BR-1 reactor was used as neutron source. The neutron spectrum at the point where the Doppler effect measurements were carried out was close to the asymptotic spectrum of the medium being studied. Measurements taken on this spectrum in the energy range below 10 keV using a set of resonance detectors showed satisfactory agreement with calculated data obtained from the system of constants evolved by V. V. Bondarenko, M. N. Nikolaev, L. P. Abagyan and N. O. Bazazyants. The reaction rate in a heated sample was measured in relation to that in a cold sample irradiated at the same position in the reactor. Gamma rays of energy 74 keV accompanied by beta decay of ^{239}U were recorded. Measurements were carried out in the temperature range 300 to 2000°K. The effect of the sample dimensions on the measurement results was established, as also was the effect of surrounding the sample by a layer of scattering material (heater material, container material, etc.). The accuracy of the results obtained was 5 to 6%. It is shown that in the temperature dependence of the proportional increase in the $^{238}U(n,\gamma)$ reaction rate in a small heated sample can be written in the form: $\Delta A/A\ (T_2) = b(\sqrt{T_g} - \sqrt{T_x})$ where T_x = 300°K and $b = 0.0132 \pm 0.0004\ (^\circ K)^{-\frac{1}{2}}$. The experimental value for the Doppler increase in the $^{238}U(n,\gamma)$ reaction rate in a small sample at T_g = 800°K agrees well with the calculated results. The error in calculating the Doppler effect due to the inadequate knowledge of the neutron spectrum was not much greater than the error in the experimental data. (auth)

35641 VARIATION OF k-inf WITH COOLANT DENSITY FOR A PLUTONIUM-FUELLED STEAM-COOLED FAST REACTOR LATTICE. COMPARISON OF EXPERIMENT WITH PREDICTION. Arnold, M. J.; Fox, W. N.; George, C. F.; Richmond, R. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 429-50 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The design of a steam-cooled fast reactor with satisfactory safety and control characteristics and an acceptable breeding performance requires an accurate knowledge of the neutron balance and its variation with coolant density. When an assessment of such a system was undertaken the basic nuclear data available for use in the lattice calculation was of insufficient accuracy and little integral information on lattices of the required composition was available. A program of experimental measurements of the neutron balance and its variation with coolant density in lattices of this type was therefore undertaken. Measurements of important neutron reaction rates and of k-infinity were carried out in the reactor DIMPLE at A.E.E., Winfrith, in a small central fast reactor zone driven critical by a surrounding thermal reactor zone. This system produced at its center the correct fast spectrum while requiring only 50 kg of Pu in the central fast test zone. Three lattices were studied in which appropriate polypropylene plates were inserted in a regular array to simulate the flooded condition, and the operating condition (0.1 g/cm^3 equivalent steam density); the voided condition was studied by removing the plates. In all three lattices studied, the most important reaction rates influencing the coolant coefficient of k-infinity were fission in ^{239}Pu, capture in ^{238}U and to a lesser extent capture in ^{239}Pu. Particular attention was therefore paid to the direct measurement of these quantities which, together with other relatively unimportant fission rates, accounted for 80 to 90% of the total lattice absorption. In one lattice these measurements were supplemented by a direct measurement of k-infinity to provide a check on the calculation of unmeasured reaction rates. (auth)

35642 MEASUREMENTS OF THE PHYSICS CHARACTERISTICS OF THE FAST PULSED REACTOR, VIPER. McTaggart, M. H.; Goodfellow, H.; Long, R. L.; Weale, J. W. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). pp 551-63 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

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The VIPER pulsed reactor was first made critical on 26 May 1967. The physics measurements carried out during its subsequent commissioning to prompt critical are described. These experiments include the measurement of reaction rate distributions, perturbation effects, neutron spectrum, neutron lifetime, and prompt temperature coefficients of reactivity. The measured characteristics of prompt critical transients are compared with predictions based on calculated expansion and Doppler effects. (auth)

35643 NEW FAST PULSED REACTOR, VIPER. Weale, J. W.; Goodfellow, H.; McTaggart, M. H.; Warnke, E. G. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). pp 533-49 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

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The design of a new, versatile fast pulsed reactor is described. The reactor is fueled with uranium of medium enrichment in the form of metal rods set in a matrix block. The composition of the matrix block and the disposition of the fuel elements can be varied. The reactor is pulsed into the prompt critical condition by rapid insertion of a fuel rod and the subsequent nuclear transient is terminated by the inherent negative temperature coefficient of reactivity. The important new features of this reactor are that the Doppler effect in ^{238}U provides a large part of the temperature coefficient and that the core composition can be changed so as to vary both the neutron lifetime and the Doppler effect. (auth)

35644 THEORETICAL ANALYSIS OF HYPOTHETICAL DESTRUCTIVE ACCIDENTS IN A PULSED FAST REACTOR. Randles, J. (Joint Research Centre, Ispra, Italy). pp 499-532 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The novel feature of a pulsed fast reactor is the existence of a relatively heavy rotating pulsation device carrying part of the reflector. The worst hypothetical accident in such a system takes the form of a fracture in the device during operation and the creation of a high speed fragment which strikes and compresses the core into a dangerously prompt critical assembly. The kinematics and dynamics of this collision process are described on the basis of a series of models which make possible an estimate of the reactivity input accompanying the accident. The effect of this input is described by means of a modified Bethe-Tait model of the neutronics and hydrodynamics of fuel vaporization and core destruction. The equation of state required to calculate the pressures generated during this process and the subsequent conversion of the energy release into mechanical work are discussed and calculations which evaluate the required parameters on the basis of the principle of corresponding states (using a computer program EQUSTA) are described. The presentation of the above models is accompanied by a detailed mathematical exposition. A numerical method of solving the equations is described briefly and the results of applying this method to a SORA-type system, using a computer program SOREX 1, are presented. These results give an upper limit to the available mechanical work in a large range of hypothetical accidents. The necessity for further information on the equation of state of fuel materials at high pressures and temperatures is demonstrated. (auth)

35645 CALCULATION OF HETEROGENEITY EFFECTS IN FAST CRITICAL ASSEMBLIES. Cermak, J. (Nuclear Research Inst., Rez, Czechoslovakia). pp 257-69 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The physical properties of the fast power reactor cores with respect to the neutron transport are usually not essentially influenced by the heterogeneity of the core structure. Nevertheless, when modeling the cores of these reactors by experimental critical assemblies the heterogeneity of the structure becomes essentially greater and cannot be neglected in the analysis of experiments. In connection with this fact a further development of the previously presented method of homogenization of slab lattices with respect to the chain reaction with fast neutrons is contributed. Attention is restricted to bare assemblies made up of a periodic lattice of parallel slabs of two different materials, a so-called "sandwich" reactor of materials 1 and 2. The geometry considered is (a) the plane geometry with boundaries parallel to the slabs, (b) the plane geometry with boundaries perpendicular to the slabs, and (c) the cylindrical geometry with boundaries perpendicular to the slabs with infinite or finite height. The restriction to two different media is made because of a simplification only and is not substantial. The starting point is the integral transport theory based on the solution of the kinetic Boltzmann equation. The solution is sought in the form of a product of asymptotic transport theory solution characterized by the buckling ^2B and representing the general trend of the neutron emission density with the "fine structure," taking account of the heterogeneous structure of alternative layers of media 1 and 2. As a result the value of the buckling ^2B of the heterogeneous assembly together with energy spectra in each medium is obtained. As an illustration of the method the chain reaction with fast neutrons in a heterogeneous medium consisting of ^{235}U and ^{238}U plates placed in turn is investigated. For 16 energy groups the buckling ^2B and the energy spectrum in ^{235}U and ^{238}U have been calculated for a 10, 20 and 30% enrichment with ^{235}U for different cell dimensions of the lattice. In each case when going from the most homogeneous to the most heterogeneous arrangement (for the same enrichment) an increase in the value of the buckling was observed. Finally the possible errors of the method are estimated. (auth)

35646 HETEROGENEITY CALCULATIONS INCLUDING SPACE-DEPENDENT RESONANCE SELF-SHIELDING. Wintzer, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp 237-55 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (EURFNR-402).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

For fast reactors with relatively soft spectra, the influence of heterogeneity on resonance self-shielding becomes important. The widely used Bell-approximation is not applicable if the lattice cell contains an important resonance material in more than one region. The problem of different weighting spectra in different regions of the cell arises. For this problem a method is proposed in which the weighting spectrum for the evaluation of group parameters is built up by a set of spectra of fictive homogeneous media, characterized by an appropriately chosen set of dilution parameters. The weighting factors for the fictive spectra can be determined, and the group parameters can be calculated using tabulated self-shielding factors for cross-sections. The method is formulated in terms of collision probabilities. It is restricted to the NR-approximation, but is not restricted to special cell geometries. Furthermore, it is not restricted to rational approximations for the collision probabilities. The method is used in a multigroup cell code with DB^2-corrections to calculate: (a) reaction rates and fluxes for each energy group and for each cell region; (b) k_{eff}-values for the unreflected lattice; (c) cross-sections "corrected" for heterogeneity to be used in global multigroup diffusion calculations. The group diffusion constants are calculated using Benoist's formula and by neglecting anisotropy of the group diffusion constants. The heterogeneity effect on diffusion constants causes a tendency for the total heterogeneity effect on reactivity to become negative in the outer core region. For a series of reactor lattices, numerical results are shown and compared with experimental results. (auth)

35647 HETEROGENEITY STUDY FOR AN INTERMEDIATE-ENERGY CORE PROGRAMME. Kuroi, H.; Tomioka, H. Y.; Mitani, H.; Hirota, J. (Japan Atomic Energy Research Inst., Tokyo). pp 223-36 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

An intermediate energy spectrum core program has been proposed and will be carried out very soon in the JAERI fast critical facility, especially for obtaining information on the group constants in the resonance-energy region. Various analytical results, obtained for the program by use of the ABN cross-section set, are discussed. The intermediate-energy core will be composed of 20%-enriched U metal plates and a suitable amount of hydrocarbon compound or Be. To obtain information on the cross-sections from the so-called integral experiments, it is necessary to carry out the experiments in the varied series of an appropriate system. One such series can be achieved by changing the moderator atomic density $N^{Be}/^{235}N$ in the range 0 to 100. It is shown that valuable information on the cross-sections in the resonance-energy region may be obtained from various experimental results, including those on the criticality, the heterogeneity effect on the criticality induced from the configuration of fuel plates, and the Doppler effect, because the contribution from the resonance-energy region to the experimental results is large. The heterogeneity effect on the criticality in the intermediate-energy core is shown to be interesting and different from that in the fast reactor system. This is caused by the difference in the fission-capture ratios of the heterogeneous and homogeneous system due to the different self-shielding factors of fission and capture cross-sections. Doppler measurement by heating a sample is discussed with emphasis on the heterogeneity effect of the sample. Highly sensitive Doppler reactivity change of the sample and considerable amount of the moderator used in the system are useful for measuring the heterogeneity effect of the sample. The importance of the contribution of gross neutron spectrum variation to the Doppler effect of the system are also discussed in a sample calculation. (auth)

35648 CALCULATION OF HETEROGENEOUS EFFECTS IN FAST-NEUTRON CRITICAL ASSEMBLIES. Sirotkin, A. M. (Moscow Engineering-Physical Inst.); Slesarev, I. S.; Khromov, V. V.; Yurova, L. N.; Troyanov, M. F. pp 207-21 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In Russian).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

A method developed for analyzing heterogeneous effects in fast-neutron critical assemblies consisting of zones with alternate flat layers of various materials (BFS-type assemblies) is described. With the method of calculation adopted the effect of heterogeneous phenomena in assemblies with zones having different properties can be accurately estimated by reducing two-dimensional calculations to equivalent one-dimensional calculations; this involves the use of group bucklings which take into account the flow of neutrons between the assembly zones. The magnitude of the group bucklings in zones of different average composition was determined by two-dimensional multi-group diffusion calculations for assemblies with homogenized zones based on the generalized method for conventional separation of spatial variables. The heterogeneous structure of the zones was studied using 18-group one-dimensional non-diffusion calculations and simultaneously considering up to 60 layers with different nuclear properties. This theoretical study resulted in a new method of solving the kinetic equation for neutron transport in multilayer media. The studies also dealt with the effect of heterogeneous structure on the spatio-energetic distribution of neutrons, the effective multiplication factor and other characteristics in the BFS-8 and BFS-16 critical assemblies. The first of these is a reactor of simple composition, and the second is a BN-350 reactor mock-up of complicated heterogeneous structure. With the method used it was possible to take into account the irregular arrangement of the layers simulating the composition of active zones of varying degrees of enrichment in the BFS-16 assembly. It is shown that, with a zone of heterogeneous structure, taking account of the arrangement of the layers in the entire zone results in a big correction to the change in the multiplication factor obtained by the lattice method of calculation. With the BFS-8 assembly a study was made of the effect of changing the structure of the elementary cells of the active zone for the same average homogeneous cell composition. Details of the spatial distributions of the neutron flux in different energy groups and the density of various reactions are given, indicating the character of the flux oscillations and the spectrum changes by the heterogeneous structure of the zone. The calculated data are compared with experimental data and shown to be in good agreement. (auth)

35649 HETEROGENEITY IN THE MASURCA 1-A ASSEMBLY. Khairallah, A.; Lacapelle, T.; Storrer, F. (Association Euratom-CEA, Cadarache, France). pp 189-205 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

Described is a study of the heterogeneity problem in the 1-A core of MASURCA. Attention is given mainly to the effects of heterogeneity on the critical mass, which are studied under two headings: (1) effects of heterogeneity in an infinite medium, including the effect of the metal plugs of the fuel rods — the calculations were carried out with both a Monte Carlo code and the PERHET code; (2) effects of heterogeneity on leakages, including the effect of the cooling spaces round the rods and the interstices between tubes — the calculations were carried out with a Monte Carlo code and by the Benoist methods for calculating leaks. The results are presented and discussed. (auth)

35650 MEASUREMENT OF THE EFFECTIVE CAPTURE-TO-FISSION RATIO IN ^{239}Pu AND ^{235}U IN TWO DIFFERENT FAST REACTOR SPECTRA. Andersson, T. L.; Hellstrand, E.; Hakansson, R.; Bajbor, Z. (AB Atomenergi, Studsvik, Sweden). pp 171-85 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

Integral values of α for ^{235}U and ^{239}Pu have been deduced from experiments in two different cores (median ^{235}U fission energy 50 and 180 keV, respectively) in the FRO reactor. The method of measurement is the same as that used for instance at ZEBRA. The experiment includes reactivity measurements of the sample material and of a standard, ^{10}B, as well as an absolute determination of the fission rate in ^{239}Pu and ^{235}U and the capture rate in ^{10}B. The experimental α values agree well with the calculated ones for the hard spectrum core measurements, both for ^{235}U and ^{239}Pu. The measured value for ^{239}Pu in the soft core is slightly higher than the calculated one. The discrepancy for ^{235}U is large and hitherto unexplained. (auth)

35651 STUDIES OF THE DOPPLER COEFFICIENT AND THE REACTIVITY EFFECT OF POLYTHENE IN SOME FAST REACTOR SPECTRA. Tiren, L. I.; Gustafsson, I.; Hellstrand, E.; Hakansson, R. (AB Atomenergi, Studsvik, Sweden). pp 143-70 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The Doppler broadening of the ^{238}U capture and the ^{235}U fission cross-sections in fast reactor spectra has been studied by irradiating heated foils or plates of the isotopes of interest in a small furnace at the center of the zero-energy fast reactor FRO. The experiments have been applied to cores fueled with 20% enriched uranium and diluted with graphite and polythene. Very thin plates of the different core materials have been used in a region surrounding the furnace in order to minimize heterogeneity effects. The measured quantity is the difference in the induced γ-activity of samples irradiated at ambient temperature and at temperatures up to 1500°C. The effects of varying sample thickness and of scattering in the furnace wall have also been studied. Measurements of the reactivity effect of polythene have been made in two FRO assemblies. The neutron spectra of the cores were broadly similar to those of current steam-cooled fast reactor concepts. The experiments include a study of the spatial distribution of the reactivity coefficient of polythene. The results are in reasonable agreement with calculated values. The latter are sensitive to small changes in the absorption cross-section in the low neutron energy range. Most of the calculations have been made with a one-dimensional diffusion theory program using 16 energy groups but a two-dimensional code and a transport theory code have also been used. Additional measurements have been made on vertical polythene rods, 2.2 and 4.5 cm thick, inserted in the central fuel element. The measured distributions of the fission rate in ^{235}U and the capture rates in ^{55}Mn, ^{115}In and ^{197}Au inside and around the rods have been compared with results of multigroup calculations. (auth)

35652 ANALYSIS OF DOPPLER ACTIVATION MEASUREMENTS IN ZEBRA. Beynon, T. D. (Univ. of Birmingham, Eng.). pp 127-41 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

An analysis is made of some recent Doppler activation foil measurements in the UKAEA zero-power fast reactor ZEBRA. A model is used to approximate the system of a foil, oven and heterogeneous reactor by a foil and homogenized reactor. The collision probabilities obtained by this reduction are used in the computer program SDR-GENEX which produces a detailed continuous-energy slowing-down spectrum in the foil for the range 0 to 15 keV. The spectrum above 15 keV is obtained using the multigroup diffusion code SCRAMBLE. The measured (n,γ) activation ratio for a 12.19 mm × 0.254 mm U_3O_8/Ni foil is 1.024 ± 0.003 in ZEBRA core 6A and 1.020 ± 0.003 in core 6D compared with the calculated values 1.022 and 1.020, respectively. The model, although approximate in its treatment of homogenizing the reactor core, is a useful tool for understanding the more important physics of the (n,γ) activation experiment. A comparison is made of the calculated energy distributions of the Doppler effect in the foil and in the core. It shows the median energy of each distribution to be at 900 and 1550 eV, respectively. This relative displacement is attributed to the differing degree of self-shielding of the ^{238}U resonances in the foil and in the core. In the core the background scattering cross-section is about 50 barns per ^{238}U atom compared with an effective scattering cross-section of 250,000 barns in the thin foil. The effect of this dilution in the foil is to lower the Doppler contribution from the predominantly scattering resonances around 1 or 2 keV and to increase the percentage contribution of the strongly absorbing low-energy resonances. We observe this as a relative shift in energy of the foil and core Doppler distributions. The analysis shows that, by equalizing the scattering cross-section per absorbing atom in the foil and core, the activation ratio and its energy distribution are also approximately equalized in the foil and core. Therefore, the design of the activation experiment may be optimized. For example, in a typical fast reactor core, a long circular cylinder of natural uranium would require a diameter of 0.53 cm, or a 2.54-cm-dia disc a thickness of 0.33 cm, to produce an optimum response. (auth)

35653 NEUTRON SPECTRUM MEASUREMENTS IN THE FAST REACTOR ASSEMBLY VERA 19A AND TESTS OF THE TIME-OF-FLIGHT SPECTROMETRY METHOD IN VERA 5A AND VIPER 1. Paterson, W. J.; Benjamin, P. W.; Hatton, D.; McCormick, W. B.; Weale, J. W. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). pp 113-25 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The neutron energy spectrum has been measured in VERA 19A using time-of-flight methods, proportional counters and photographic plates. Assembly 19A is fueled with plutonium oxide, uranium oxide and polythene homogeneously mixed, with a H : Pu ratio of 20. It is designed to provide data for checking the accuracy of calculations of critical parameters of fast reactor fuel elements in slightly moderated assemblies. VERA 5A is fueled with ^{235}U and contains a small amount of carbon and hydrogen. It has been used for investigations into the accuracy and validity of time-of-flight spectrometry results. The time-of-flight measurements have been compared with sandwich foil activation measurements, the effect of source and beam-hole geometry has been investigated and the dependence of the results on reactivity has been measured. (auth)

35654 PHYSICS INVESTIGATIONS OF A 670-LITRE STEAM-COOLED FAST-REACTOR SYSTEM IN SNEAK, ASSEMBLY 3A-1. Stegemann, D.; Barleon, L.; Bayer, A.; (and others) (Kernforschungszentrum, Karlsruhe, Ger.). pp 79-112 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

A series of experiments is under way at the Karlsruhe fast zero power reactor SNEAK for the investigation of steam-cooled fast reactors in the 100-MW(e) range. This series started in May with the critical experiment of SNEAK 3A-1, a 670-liter uranium system containing 7.41×10^{20} atoms/cm^3 of hydrogen in the form of polyethylene foils. The neutron physics of this assembly has been studied in detail. The neutron energy spectrum has been measured by various methods from the eV-region to more than 1 MeV in the core center and at the periphery, reaction rates have been measured in the center and in axial and radial traverses, and the initial breeding ratio and the reactivity worth of selected materials have been determined. Measurements of the Doppler reactivity effect, the steam void effect and of β/l have been performed. Special attention has been given to the experimental investigation of heterogeneity effects. The experimental results are compared with calculations using the 26-group ABN set and a specially prepared 26-group cross-section set KFK-SNEAK using latest cross-section information and the SNEAK-3A spectrum as a weighing spectrum. The heterogeneity results are compared with theoretical models including space-dependent resonance self-shielding. The series of SNEAK-3 experiments is now being continued with the uranium assembly 3A-2, which has about twice the hydrogen concentration of 3A-1. After the measurements in this system have been completed the inner part of the core will be replaced by an equivalent plutonium-fueled zone thus forming the two-zone core SNEAK-3B. (auth)

35655 COMPARISON OF MEASUREMENTS IN SNEAK-1 AND ZPR III-41. Boehme, R.; Barleon, L.; Boehnel, K.; (and others) (Kernforschungszentrum, Karlsruhe, Ger.). pp 55-77 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The experimental program of the Karlsruhe Fast Zero Power Reactor SNEAK started in the autumn, 1966 with measurements on a 460-liter uranium assembly, a mock-up of ZPR III-41. During a four-month period the experimental installations and techniques of SNEAK were successfully tested. The installations include a movable drawer connected to an automatic sample changer operating in a horizontal experimental channel, a vertical drive unit, a pile oscillator, and a pulsed neutron generator. The techniques used include spectra measurements with proton recoil counters and foil activation, and several techniques for determining reactor power and β/l, e.g., Rossi- and pulsed neutron source measurements. In the experimental program quantities such as critical mass, reaction rate ratios, neutron spectrum, material worths in the center, radial and axial traverses, $\beta/1$, and reactor power were determined. The results were generally in good agreement with those of the ZPR III experiments, and the remaining discrepancies are discussed. These are partly due to small deviations in the material composition of the two assemblies. The experimental data are also compared with calculations using the 16-group YOM, 26-group KFK, and 26-group ABN cross-section sets. While critical mass is best calculated with YOM, the YOM spectrum is too hard, and both KFK and ABN give better agreement with the experimental spectrum. (auth)

35656 OPERATIONAL CHARACTERISTICS AND RELATED DESIGN FEATURES OF SNEAK. Engelmann, P.; Bickel, W.; Walze, H.; Wittek, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 35-53 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

SNEAK is a flexible zero-power reactor for investigating the physics of fast reactors with uranium and plutonium fuel. Considerations of safety, operation, and experimental flexibility led to the choice of a fixed vertical assembly with suspended fuel elements loaded into the reactor from below. A short description of the main design features and of the experimental capabilities of SNEAK is given. The safety and experimental instrumentation is described in some detail. The safety instrumentation consists of 7 channels. The signals from these channels, most of them working in 2-out-of-3 manner, are fed into a self-controlled safety circuit actuating the safety and shim rods and/or the isolation valves of the reactor building. Automatic control of reactor power is possible from 0.1 to 1000 W, i.e., in the range of the logarithmic ionization chamber channel. For very precise regulation a special "autorod" may be used in connection with one of the experimental linear channels. Linear ionization chamber channels are also used for accurate reactor operation. A deviation meter shows small deviations of reactor power from a set point. With the aid of a small on-line analogue computer continuous reactivity information is obtained. This reactivity meter has proved very useful for many kinds of experiments. The results of measurements on the reproducibility of core geometry, control rod positioning, and reactivity are summarized. Temperature variations inside the core and in the reactor building are also reported. It has been found that reactivity reproduces with high precision, and temperature variations are very small. (auth)

35657 MASURCA 1-A AND 1-B-PRELIMINARY RESULTS. Kremser, J.; Barberger, M.; Bruna, J. G.; Brunet, J. P.; Mougniot, J. C.; Schmitt, A. P.; Verriere, P. (CEA, Cadarache, France). pp 3-33 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968. (In French).

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

The MASURCA fast-neutron critical model at Cadarache went critical in December 1966 with a plutonium configuration, using graphite as diluent so as to obtain a neutron spectrum lying within the spectral range of high-power fast reactors. The construction of the first core, composed of the MASURCA 1-A lattice using a U–Pu–Fe alloy with 25% Pu, and experimental techniques are described. Spectral index measurement data and reactivity coefficients for various materials are quoted. The material buckling value of the assembly was determined experimentally using spatial distributions for various reaction rates. Some measurement data are compared with the corresponding theoretical values calculated from transport theory or by a Monte Carlo method. The causes of error and improvements which should be made in experimental methods and in interpretation of the measurements are discussed. (auth)

Reactor Theory, Components, Fuels and Accessories

Refer also to abstracts 33399, 33659, 33683, 33691, 34016, 34046, 34065, 34105, 34106, 34110, 35195–35197, 35330, 35403, 35469, and 35502.

35658 (AD–663879) AVAILABILITY OF DATA ON IRRADIATED MATERIALS AS RELATED TO DESIGN REQUIREMENTS FOR WATER COOLED REACTOR PRESSURE VESSELS. Final Report. Hawthorne, J. R.; Loss, F. J. (Naval Research Lab., Washington, D. C.). Aug. 1, 1967. 31p. (NRL–6625). CFSTI.

NRL has completed a survey of known experimental programs which have contributed to and are attempting to satisfy the data requirements necessary for the development of nuclear reactor pressure vessel specifications and operations. Designer requirements have been set forth in the report "Properties of Irradiated Materials Needed for the Design of Reactor Vessels," by D. W. McLaughlin which was presented as an ASME Research Committee report to the 1966 ASTM Symposium on Effects of Radiation on Structural Metals. This report was the primary reference used in weighing the presentation of data availability against designer requirements. An analysis of individual material properties and problem areas is presented rather than an extensive data compilation. The areas considered are low-cycle and high-cycle fatigue, brittle fracture resistance (transition temperature characteristics and fracture mechanics), static load strength, and recovery of original properties. (auth)

35659 (AEEW-R-594) HOMOGENISATION OF A WIGNER-SEITZ CELL IN TWO GROUP DIFFUSION THEORY. Allen, F. R. (Atomic Energy Establishment, Winfrith (England)). Feb. 1968. 17p. Dep. CFSTI. UK 3s.

Two group diffusion theory is used to develop a theory for the homogenization of a Wigner–Seitz cell, neglecting azimuthal flux components of higher order than dipoles. An iterative method of solution is suggested for linkage with reactor calculations. The limiting theory for no cell leakage leads to cell edge flux normalization of cell parameters, the current method for core representation in SGHW reactor design calculations. Numerical solutions are presented for a cell-plus-environment model with monopoles only. The results demonstrate the exact theory in comparison with the approximate recipes of normalization to cell edge, moderator average, or cell average flux levels. (auth)

35660 (ANL–7411) ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS. Butler, M. K.; Hollister, Nancy; Legan, Marianne; Ranzini, L. (Argonne National Lab., Ill.). Jan. 1968. Contract W-31-109-eng-38. 491p. Dep. CFSTI.

A bibliography of computer program abstracts referring to available computer programs at the Argonne Code Center is presented. (D.C.C.)

35661 (DLR-FB–66-91) BERECHNUNG THERMISCHER NEUTRONENFLUSS-SPEKTREN UND GRUPPENKONSTANTEN FUER KERNREAKTOREN. (Calculation of Thermal Neutron Flux-Spectra and Nuclear-Constants for Reactor Design). Rasch, W. (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany)). Institut fuer Strahlantriebe). Dec. 1966. 47p. (In German). Dep.

The computer program THERMOGRUP 6 is a dimensionless reactor-code to calculate the flux of thermal neutrons in the energy-range of $0 \leq E \leq 1.68$ eV. It contains an extensive collection of thermal neutron cross-sections (84 elements). Tests with the new program showed better results than with the older codes. This is caused by improvements in the theory and the numerical technique. (auth)

35662 (EURFNR–498) AUTOMATIC CONTROL SYSTEM FOR BALANCED OSCILLATOR TESTS. Audoux, M.; Caldarola, L.; Giordano, P.; Rohrbacher, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Sept. 1967. 40p. (KFK–667; EUR–3700). Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

It has been demonstrated that the Balanced Oscillator Tests are more convenient than the traditional oscillator tests. They provide accumulation of more complete and precise information on reactor parameters such as reactivity coefficients, fuel time constant, etc. A special automatic control system to carry out these experiments has been developed, built and tested on the analog computer. This type of automatic control system will perform Balanced Oscillator Tests on SEFOR (Southwest Experimental Fast Oxide Reactor). (auth)

35663 (GA–7542(Vol.1)) THE GAF/GAR/GAND FAST REACTOR CROSS SECTION PREPARATION SYSTEM. VOLUME I. GAFGAR: A PROGRAM FOR THE CALCULATION OF NEUTRON SPECTRA AND GROUP-AVERAGED CROSS SECTIONS. Archibald, R. J.; Mathews, D. R. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 22, 1968. Contract AT(04-3)-167. 152p. Dep. CFSTI.

The GAFGAR program is a combined and considerably revised version of the GAF and GAR programs featuring fully automated multigroup cross section combining and punching routines and problem repeat options as well as a much faster recursive slowing down calculation in the GAR section and more efficient data tape formats. The purpose of GAFGAR is to accurately and efficiently solve the B_1 equations for neutron flux and current distributions as functions of energy considering explicitly the possible overlap effects between resonances of a resonance absorber and of mixtures of resonance absorbers and to use these distributions to prepare group-averaged cross sections and transfer arrays for use in fast reactor analyses. The program is written in FORTRAN-IV and has been run on a UNIVAC-1108 computer. (auth)

35664 (KAPL-3199) LWB/LSBR DEVELOPMENT PROGRAM: TEMPERATURE DISTRIBUTIONS WITH SELF-SHIELDING. Anderson, W. K.; Koenig, E. F.; Hansen, E. C.; Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1967. Contract W-31-109-eng-52. 13p. Dep. CFSTI.

The computer program MUTTR, a method of obtaining temperature distributions in oxide fuel rods, is described. Using any source of self-shielding information, MUTTR establishes the fuel temperature distribution for either a constant volumetric source or for self-shielded models. Unpublished work by E. C. Hansen is reviewed. This work involves the use of DRAM, a general-purpose Monte-Carlo program, which computes fission distributions in a model fuel rod. Results of DRAM calculations are cited to implement the comparison of two models of self-shielding used to program MUTTR. Results compare temperature distributions in a selected annular fuel rod for (1) constant volumetric source, (2) the DRAM thermal fission distribution, and (3) the distribution based on DRAM prediction of total fissions. (auth)

35665 (KAPL-3300) LWB/LSBR DEVELOPMENT PROGRAM: SOME INPUT PROPERTIES FOR COMPUTER DESCRIPTION OF FUEL PROPERTIES. Anderson, W. K.; Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1967. Contract W-31-109-eng-52. 18p. Dep. CFSTI.

Use of analytic functions to input various physical properties of materials in a computer routine is discussed. Among thermal properties, equations for gap or contact conductance, thermal conductivity of fuel, and thermal conductivity of Zircaloy-2 cladding material are presented. Among mechanical properties, computational schemes for fuel viscosity, Young's modulus for Zircaloy and for fuel, and coefficient of thermal expansion for fuel are included. Comparisons of computed values with experimental data are shown in several curves. (auth)

35666 (N-68-10023) PREDICTION OF NEUTRON INDUCED ACTIVATION. VOLUME II. NAP, PHYSICAL MODELS, AND EXPERIMENTAL VALIDATION. Final Report, May 14, 1964–January 31, 1966. Klopp, David A. (IIT Research Inst., Chicago, Ill.). Contract NAS8-11160. 177p. (NASA-CR-89958; IITRI-A-6088-22(Vol.2)). CFSTI.

An IBM 7094 computer program was written for the prediction of neutron induced activation. The physical models which form the basis for the computer programming and the experimental validation of the computer program are described. The physical models discussed include one-dimensional neutron transport, estimation of neutron activation cross sections, and time dependence of radioisotope atomic concentrations. The experimental validation compares computed results of the NAP code, including neutron flux distribution, cross section calculation, and neutron induced gamma ray source strengths, to experimental data presented. (auth)

35667 (NAA-SR-Memo-12288) SURFACE-TO-MASS AND HETEROGENEITY EFFECTS ON THE SPECIFIC REACTIVITY OF SELECTED MATERIALS IN A FAST NEUTRON SPECTRUM. Mountford, L. A.; Springer, T. H.; Carpenter, S. G.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.). Mar. 7, 1967. 21p. (CONF-661001-57). Dep. CFSTI.

From 14th Conference on Remote Systems and Technology, Pittsburgh, Pa.

The reactivity worths of several samples of U (of several enrichments), Th, Ta, and W have been measured in a neutron spectrum characterized by a median fission energy of 63 keV. The results have been used to determine the dependence of the specific worths on the surface-to-mass ratio (S/M) of the samples. The dependence on enrichment has also been measured for U with heterogeneous mixtures of ^{235}U and ^{238}U showing that the effect of using two samples of different enrichment was little different from that of using a corresponding uniform enrichment. The reactivity effect of thermal expansion was calculated from the (S/M) dependence and used to correct the total temperature coefficient of reactivity to obtain the effect of Doppler broadening. (auth)

35668 (ORNL-RSIC-22(Pt.2)) COMPARISONS OF RESULTS OBTAINED WITH SEVERAL PROTON PENETRATION CODES. Scott, W. Wayne; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 28p. Dep. CFSTI.

Comparisons obtained with two proton penetration codes, CHARGE written by J. R. Lilley and W. R. Yucker and ASTROS written by R. Wallace, P. G. Steward, and C. Sondhaus, which have been added to the code collection of the Radiation Shielding Information Center, are presented. The hypothetical problem considered is to find the dose as a function of depth in tissue when a typical solar-flare proton spectrum is incident on a semi-infinite slab of aluminum followed by tissue and to find the dose as a function of depth when monoenergetic protons are incident on a semi-infinite slab of tissue. (auth)

35669 (ORNL-TM-2034(Vol.3)) REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME III. REACTOR PHYSICS. Costner, R. A. Jr.; Cramer, E. N.; Scott, R. L. Jr. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 228p. Dep. CFSTI.

Material on the physics of nuclear reactors is presented in the form of small "frames" which contain information in easily digestible steps. Self-test questions are included at the end of each section for review. Separate sections discuss: neutron reactions, nuclear reactors, reactivity and reactor period, fuel burnup, xenon and samarium poisoning effects, temperature effects, and neutron flux distribution. (H.D.R.)

35670 (ORNL-TM-2034(Vol.5)) REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME V. INSTRUMENTATION AND CONTROLS. Costner, R. A. Jr.; Cramer, E. N.; Scott, R. L. Jr. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 257p. Dep. CFSTI.

Information on the basic aspects of nuclear reactor instrumentation and controls is presented in the form of frames which contain data in small, easily digestible steps. Separate sections include: principles of electricity, radiation detection, philosophy of reactor control, control instrumentation, instrument behavior during an orderly reactor startup, and process instrumentation. Self-test questions for review are included at the end of each section. (H.D.R.)

35671 (PNR/SETR-R.-014) PROGRAMME INDIGO: RESOLUTION ANALYTIQUE DE L'EQUATION DE LA DIFFUSION A UN GROUPE DE NEUTRONS ET A UNE DIMENSION POUR UN REACTEUR A PLUSIEURS MILIEUX HOMOGENES. ("INDIGO" Code: One-Group, One-Dimensional Diffusion Code for Analytic Computation of Reactor Codes with Several Homogeneous Media). Giacometti, C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Apr. 1967. 59p. (In French). Dep.

The "INDIGO" code solves analytically the diffusion equation in one-group and one-dimension theory (sphere, cylinder and slab). The code provides the long term behaviour and the determination of the ratio E_1/E_2 of the enrichments of two fissile zones for a given value of the maximum specific power ratio of these two zones (power flattening studies). The code is written in FORTRAN IV language for the IBM 360. (auth)

35672 (RT/FI-(68)10) THE GLOBPERT-1D CODE. Dal Bono, I.; Leproni, V.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 13p. (PRV-r-(67)13). Dep.

The GLOBPERT-1D computer program is presented which calculates the fractional variation of a ratio of the bilinear functionals of the real and adjoint neutron fluxes or of the ratios of two linear functionals of real and adjoint neutron fluxes according to generalized perturbation methods. The computer program is written in FORTRAN-II for IBM 7094 computer. (D.C.C.)

35673 (RT/ING-(67)11) FRG: UN PROGRAMMA PER LA DETERMINAZIONE DEI FATTORI DI PUNTO CALDO CONSEGUENTI A DISOMOGENEITA GEOMETRICHE DELLA BARRA COMBUSTIBILE. (FRG: A Program for the Evaluation of the Hot Spot Factors due to Fuel Rod Geometrical dishomogeneities). Cherubini, A.; Grillo, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 26p. (In Italian). Dep.

The heat overfluxes transferred to coolant due to fuel pellet eccentricity or to cladding ovalness is determined. Both these geometrical factors induce a circumferential variation on the fuel-cladding gap dimension, entailing a correspondent variation on its thermal conductance. The program determines the influence of such variation on the temperature and heat flux distribution of fuel rod, with the aim of evaluating the hot channel factors or the hot spot factors which should be considered in the fuel rod thermal design. Program use and input are described. (auth)

35674 (WAPD-TM-735) FLOW CALCULATION FOR LOSS OF FLOW AND OTHER TRANSIENTS FROM VENTURI TUBE PRESSURE MEASUREMENTS. Coffman, W. A.; Porsching, T. A. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jan. 1968. Contract AT(11-1)-Gen-14. 37p. Dep. CFSTI.

A differential equation is formulated to represent mathematically the momentum transformations which occur in transient fluid flow between the approach and throat pressure tap planes of a Venturi tube. The equation is solved numerically for the transient flow rate by means of a digital computer program.

Assumed known are the Venturi tube geometrical configuration and the transient pressure record which is used as the focusing function. A particular application is flow determination within a nuclear reactor plant during the transient imposed by the loss of flow test condition. (auth)

35675 APPLICATION OF MULTIGROUP METHODS FOR THE CALCULATION OF NEUTRON FLUX DISTRIBUTIONS IN INHOMOGENEOUS SHIELDS. Broder, D. L.; Kondrashova, Z. S.; Kudryavtseva, A. V.; Levin, V. V.; Markelov, I. P.; Polivanskii, V. P. (Inst. of Physics and Power Engineering, Obninsk, USSR). Kernenergie, 11: 77-81(Mar. 1968). (In Russian).

Multigroup methods are used to determine homogeneous or multilayer infinite one-dimensional shielding characteristics; two-dimensional four- and eighteen-group calculations are performed using the P_1 approximation of the spherical harmonics method. The constants L_{eff} and D_{eff} are computed; a two-dimensional fast neutron angular distribution can be determined from these. The accuracy of the method is analyzed; errors in the various approximations of spherical harmonics are evaluated. Calculated results are compared with experimental data. (M.L.S.)

35676 MEASURING PROBE FOR THE DETERMINATION OF COOLANT DISTRIBUTIONS AND INVESTIGATIONS OF LOCAL COOLING CONDITIONS. Grunwald, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 11: 72-3(Mar. 1968). (In German).

The construction and the mode of operation of the measuring probe is described. The arrangement is tested successfully in the Rossendorf research reactor WWR-S. As compared with conventional flowmeters, the transfer of the measuring values is carried out by means of electrical quantities. The arrangement seems to be well fitted for the use in reactor technology. (auth)

35677 LIMIT ESTIMATION OF QUALITY OF NEUTRON FLUX MEASURING IN NUCLEAR REACTOR. Potapenko, P. T. At. Energ. (USSR), 24: 340-3(Apr. 1968). (In Russian).

The problem of the quantity neutron flux detectors and their displacement in the reactor core is described. The formula for the distance estimation between two detectors (the step detectors grating) is recommended. The step of detectors grating physical constants of the reactor core (migration length) and the given accuracy of maximum neutron flux measuring are described. (auth)

35678 MULTIGROUP ANALYTICAL METHOD OF CALCULATION OF HETEROGENEOUS NUCLEAR REACTOR. Barkov, S. N. At. Energ. (USSR), 24: 335-40(Apr. 1968). (In Russian).

A method for the calculation of the heterogeneous nuclear reactor without end reflectors in P_1–approximation is described. The multiblanket cylindrical reactor with multiplying or absorbing rods in central zone is examined. For every zone matrix-vectorial neutron diffusion equation is solved. In obtained expressions for the neutron flows and for the critical condition only such combination of Bessel functions are presented for the calculation of the transition matrix for the different zones. Such solution eliminates the problems of the own values of this matrix. This method is common for the calculation of: the heterogeneous reactors with nonmultiplying moderator; the homogeneous reactors with the systems of the multiplying or absorbing rods; and the thermalization effects in the heterogeneous or homogeneous reactors. (auth)

35679 INVESTIGATION PROGRESS IN THE INSTITUTE OF NUCLEAR POWER OF THE BELORUSSIAN ACADEMY OF SCIENCES. Krasin, A. K.; Salamatov, I. I.; Nesterenko, V. B.; Devoino, A. N. At. Energ. (USSR), 24: 307-11(Apr. 1968). (In Russian).

A brief review is given on nuclear reactor physics dealing with the principles of chemically reacting gases used as reactor coolants. Descriptions are given for special nuclear reactors used for handling radio-chemical processes and for radio-modification of materials. (R.V.J.)

35680 APLICATIILE CALCULULUI MATRICEAL IN FIZICA SI TEHNICA REACTORILOR NUCLEARI. (Application of Matrix Calculations in Physics and Technology of Nuclear Reactors). Rosescu, Teodor. Bucuresti, Editura Academiei Republicii Socialiste Romania, 1968. 347p.

A review is given of elements of matrix calculations considering various types of matrices, their properties, matrix operations, and eigenvalue of matrices. Neutron diffusion approximation, radiation shielding, neutron transport approximations, reactor kinetics and stability, and convergence criteria of matrix methods are discussed. Nuclear reactions and transformations and nuclear cross sections are also discussed, as well as handling of nuclear experimental data and optimization of reactor nuclear processes. (R.V.J.)

35681 REACTIVITY CALIBRATION BY A DIGITAL ANALYSIS OF FLUX TRANSIENTS. Anselmi, L.; Hage, W.; Hettinger, H.; Kumpf, S. (EURATOM, Ispra, Italy). Nukleonik, 11: 1-4(Mar. 1968).

The nonlinear, space independent reactor kinetic equations are solved in finite time steps. The reactivity of a reactor is expressed as a function of the neutron population measured in consecutive time intervals. Examples of application for control rod calibrations are given. The experimental results reported come from the ESSOR zero power experiments. (auth)

35682 METHOD OF AND APPARATUS FOR DETERMINATION OF NUCLEAR POISON. Puechl, Karl H. (to Nuclear Materials and Equipment Corp.). U. S. Patent 3,375,371. Mar. 26, 1968. Filed May 18, 1964.

A method for non-destructive determination of ^{10}B concentration in stainless steel is presented. The specimen absorbs thermal neutrons, completely passes fast neutrons, and partly absorbs epithermal neutrons. The epithermal neutrons emitted by the specimen are then detected and measured an induced radioactivity. (Offic. Gaz.)

35683 CRITERIA FOR BUILDING SITES OF REACTORS IN THE NETHERLANDS. Weber, J. (Reactor Inst., Delft, Netherlands). RCN (Reactor Cent. Ned.) Meded., No. 27, 21-38(1968). (In Dutch).

Both the probability of an accident in a nuclear reactor and the amount of liberated radioactive material and its spreading in the surroundings are independent problems when determining the most safe building site. Information obtained from a U. S. accident, the Windscale (U. K.) accident and the Jülich (Germany) accident is used to develop a system of classification of building sites. Examples of several sites in the Netherlands are given. Such a classification system can be used as a tool to decide upon a building site after admissible risks have been established and economic factors have been determined. (J.J.t B.)

35684 REACTOR LEVEL DETERMINATION WITH STATISTICAL γ DISCRIMINATION. Mogil'ner, A. I.; Morozov, S. A. At. Energ. (USSR), 24: 151-4(Feb. 1968). (In Russian).

A method for the determination of the output level of reactors (neutron flux) by the size of the fluctuation of the current of a neutron detector was described. A useful plan for the measurement of the output of the reactor was given. It was shown that the use of this method makes it possible to expand the limits of the measurement of reactor level under conditions of high γ background. (tr-auth)

35685 CALCULATION OF INTERRUPTED CONTROL ROD WORTH IN CYLINDRICAL REACTOR. Voronkov, A. V. At. Energ. (USSR), 24: 154-8(Feb. 1968). (In Russian).

A two-group method for the calculation of interrupted control rod worth in a cylindrical reactor without reflector is given. Th control rod worth and the distribution of the neutron flux in the reactor were found for absorbers of different geometry. (tr-auth)

35686 NUCLEAR REACTOR SYSTEMS: DECONTAMINATION. Larrick, A. P.; Weed, R. D. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Mater. Protect., 7: 34-7(Apr. 1968).

The problem of alkaline stress corrosion cracking of steels in nuclear reactor systems was examined by tests of cracking of pilot plant loop equipment and steel test coupons. Also, complete immersion and rinsing effects on cracking were studied. Under lab conditions stainless steel and carbon steel samples did not crack when immersed for 1 month at atm pressure in boiling solutions of 3% $KMnO_4$ with caustic concentrations up to 18%. Cracking did not occur in pilot plant loops on samples with relatively simple crevice geometry from which caustic solutions could diffuse back to the recirculating water following exposure to the caustic solutions. Cracking did not occur within 2 to 4 weeks when the caustic was firmly entrapped in crevices during exposure to the caustic solutions and heated to 300°C during subsequent high temperature operation simulating nuclear reactor operation. Loop components cracked after 4 to 5 yr of service with alternating exposure to caustic cleaning solutions and high temperature water. This was due to concentration of caustic at minor leak areas where dilution did not occur during subsequent operation. It was concluded that alkaline stress corrosion cracking would not result from the use of alkaline permanganate decontaminating solutions unless the system contains crevices or leak areas which cannot be rinsed effectively. (BBB)

35687 AN ANALOG SIMULATION OF THE CHEZEM–HELMICK MODEL OF A TWO-CORE REACTOR. Campos, Alberto Manuel. Ames, Iowa, Iowa State Univ., 1967. 102p. Thesis.

An analog computer circuit is developed for the simulation of the neutronic behavior of the two cores of a coupled-core reactor according to the model of Chezem and Helmick. The Laplace transform forms of the equations are used and these are solved as differential equations. The analog simulator consists of four amplifier-integrators, four amplifier-summers and 9 potentiometers, and permits simultaneous reading and recording of the neutron generation rates in both the pulsed core and the passive core. This analog simulator circuit has been checked with the four cases experimentally studied by the proponents of the model and was found accurate to within the accepted limits for analog computer calculations for runs not exceeding about 30 seconds of machine time. It has also been applied to a study of the effect of reactivity drops in either core on the neutron generation rates, and the results obtained have been in accordance with the accepted models of neutron propagation and multiplication processes, except in the case where the effect of reactivity changes in the passive core was considered. In this case however it was found that the error arises from the addition of voltage errors inherent in the amplifiers themselves; this conclusion was based on the results obtained with three closely related cases, first considering the full expression consisting of four negative-exponential terms and then considering only the two terms, neglecting the more rapidly decaying higher exponential terms. (Disser. Abstr.)

35688 SOLUTION OF SPACE-TIME KINETIC EQUATIONS FOR COUPLED-CORE NUCLEAR REACTORS. **Carter, Neal Edward. Ames, Iowa, Iowa State Univ., 1967. 150p. Thesis.**

The modal analysis technique has been used to solve the space-time kinetic equations for coupled-core nuclear reactors. The neutron flux is expanded in a series of space dependent basis functions having time dependent expansion coefficients. The Green's Function Modes, obtained by solving the diffusion equations with sources fixed in various subregions of the reactor, were used as the space functions, and a variational principle was utilized to determine a set of time coefficients for the modes. The most significant advantage of the overall analytical technique is its versatility. The technique enables one to obtain the response of a reactor to perturbations of a step, ramp, or oscillatory nature. The space modes are determined as the solution to a set of differential equations with certain boundary conditions, and the solution involves no source iteration in that the only information required is the solution to the steady state problem. It was found that an extension was required to generate space modes that would represent non-multiplying regions. By employing a suitable division of the removal operators, a pseudo production operator was generated for the coupling regions which in turn made possible the generation of space modes for these regions. It is quite significant that the choice of the relative division of these operators does not affect the final expression for the time dependent flux. In the variational technique a functional is established whose Euler equations are the neutron kinetic and adjoint kinetic equations. After a separable trial function is substituted into this functional, taking the first variation leads to a set of first order, linear differential equations whose solution represents the time coefficients. Three techniques were investigated as possibilities for solving these equations. The eigenvalue method proved to be a fast and easy method except for the more complex problems analyzed wherein it became very difficult to obtain all the eigenvalues and eigenvectors of the very large matrices involved. A Runge-Kutta numerical routine was very successful in solving the differential equations after the fast neutron lifetime was removed from the analysis. The exponential method was perhaps the most successful method investigated. Even in the most complex problems analyzed the only effect on the exponential method was an increase in the size of the matrix U in e^U. This increase only results in a slightly longer convergence time on the digital machine. The most complex description of the reactor used was a two-energy-group analysis, including one group of delayed neutrons. The time dependent fast and slow fluxes resulting from a step reactivity input are displayed, and the space dependent frequency response to an oscillating absorber is also demonstrated. (Disser. Abstr.)

35689 TWO-GROUP DIFFUSION APPROXIMATION OF REACTOR TRANSMISSION FUNCTIONS. **Shishkin, G. V. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk, No. 3, 124-6(1967). (In Russian).**

Transmission functions actually include within themselves information on mutual correlations of inlet and exit fluctuations of a system. The mutual relation between a series of transmission functions of a subcritical reactor (non-steady-state) is obtained by a two-group diffusion approximation with the delayed neutrons being taken into account by placing in a single group with average parameters. Two possible cases of initial perturbations are considered: perturbations of source power and perturbations of reactivity. Homologous relations are established between the transmission functions. It is concluded that reactivity fluctuations lead to large changes in neutron flux at high power levels, while fluctuations in source power are more important at low reactor power. (TTT)

35690 MEASUREMENTS OF THE PARAMETERS OF UNIFORM HYDROUS URANIUM ACTIVITY ZONES WITH A FINE-SCALE HETEROGENEITY. **Kontrovskii, S. N.; Levadnyi, V. A.; Yaroshevich, O. I. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk, No. 3, 32-7 (1967). (In Russian).**

The effective multiplication coefficient is given as $k_{eff} = k_\infty f(x^2m^2)$. Here $f(x^2m^2)$ is the probability for a neutron to avoid leakage from the reactor; x^2 is the geometrical parameter, and m^2 is the migration area of the prompt neutrons. An expression is given for the change in reactivity on changing the geometrical parameter as a function of the height and radius of a reactor. This method of measuring the effective additions of reflector and the material buckling of the reactor can be carried out at a relatively high accuracy of ~2%. This method of determining the material buckling is particularly effective for active zones of small dimensions, for which the method of measuring the neutron density distribution cannot be used in practice. (TTT)

35691 ONLY HIGH-GAIN BREEDER REACTORS CAN STABILIZE URANIUM FUEL REQUIREMENTS. **Rengel, J. C. (Westinghouse Electric Corp., Pittsburgh). Westinghouse Eng., 28: 3-7(Jan. 1968).**

It has been estimated, that the 300 MT of Pu that will have been produced in light water reactors by 1990 will be worth about $3 billion as water reactor recycle fuel, but could be worth as much as 50% more as a breeder fuel. Since the most significant factor in stabilizing U fuel supply requirements with the breeder cycle is the doubling time of the breeder, only a high-gain breeder can have a significant effect on U requirements. The fissile-fuel doubling time should be no more than eight years. It has been estimated that for 150,000 MWe of nuclear capacity installed in 1980, U ore requirements with high-gain breeders and water reactors can be reduced by almost 50% below those for water reactors and low-gain breeders. Also, the balance would reach a point within this same period after which no additional U would be required, permitting an economic choice as to whether to mine U or use Pu and the depleted U stockpile. (BBB)

35692 METHOD FOR CONTROLLING A NUCLEAR REACTOR. **Ebata, Yasuo (to Hitachi Ltd.). Japanese Patent 1967-24618. Nov. 27, 1967. Filed Feb. 27, 1964.**

In the reactor control method proposed, when in normal operation, the insertion of a strongly absorbing control rod in the reactor core is avoided to flatten the neutron-flux distribution. As the regulating rod, a positive (neutron absorbing) shim and a negative (the opposite) shim rod, and a neutron absorber dissolved in the coolant (or moderator) are used; a device for adjusting the absorber concentration is installed in the coolant circulating system. When the regulating rod has reached the upper withdrawn limit, the negative shim rod is inserted into the core. Then, this insertion is detected, and the absorber concentration is decreased by the adjuster as the negative rod is withdrawn. (NSA of Japan)

35693 INTEGRAL NUCLEAR REACTOR-HEAT EXCHANGER SYSTEM. **Hawkins, Ronald J. (to Babcock and Wilcox, Ltd.). U. S. Patent 3,385,760. July 5, 1966. Priority date July 6, 1965, Great Britain.**

A reactor comprising a pressure vessel in which a reactor core including a fuel assembly is located below the heat exchanger tube banks is described. The assembly and tube banks are surrounded by a casing spaced apart from the pressure vessel to define an annular flow space. A plurality of chambers extending outwardly from the pressure vessel at a common level have pumps for circulating primary coolant through the vessel. Each chamber is divided into a suction and discharge zone by a member sealed to the casing and chamber so that the pump associated with a given chamber circulates coolant through the chamber, annular flow space, core and exchanger. (Offic. Gaz.)

35694 DEVICE FOR DRIVING A REACTOR CONTROL ROD. **Masuda, Yasunao (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1967-24619. Nov. 27, 1967. Filed Apr. 20, 1964.**

In the control-rod driving device described, which employs a wire-and-drum, the indication of the control-rod position is accurate and in a reactor scram the damage to the associated instrument can be prevented. It includes the following: the control rod, driven by a wire-and-drum; the drum and wire; a disk installed midway on the wire with the wire running through the disc center; a rack installed onto the disc along the wire; a pinion engaging with the rack; the position indicator, connected to the pinion; and a gear device engaging with the pinion. In a reactor scram, the disc and rack are disconnected from each other by means of the gear device, and the control rod drops by gravitation while the rack falls slowly. (NSA of Japan)

35695 EIGENFUNCTION EXPANSION METHOD IN TWO-GROUP TRANSPORT THEORY. Baran, W. (Inst. of Nuclear Research, Swierk, Poland). Nukleonik, 11: 10-16(1968).

The Case's technique is applied to the Boltzmann equation in two-group approximation for the plane geometry and isotropic scattering. The existence and properties of the discrete eigenvalues are discussed. The generalized Milne problem in two-group transport approximation is solved. (auth)

35696 IMPROVEMENTS IN OR RELATING TO CAULKING DEVICES. Pillet, Claude; Wolfer, Georges (to Commissariat a l'Energie Atomique). British Patent 1,116,607. June 6, 1968. Priority date Jan. 12, 1966, France.

A device for caulking reactor fuel elements to their supports is described. The device consists of: a multi-section plate as long as the fuel elements with the width slightly less than fuel element spacings; a cam portion of the plate with a recess connector to the plate sections; and a third section as a hook to rotate the cam. The third section has a lever arm connected to the first section. (D.C.C.)

35697 MEASUREMENTS OF NEUTRON THERMALIZATION PARAMETERS IN LIGHT WATER BY PULSED SOURCE AND NON 1/v ABSORBER METHOD. Shiba, Kiminori (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 5: 201-9(May 1968).

Measurements of thermalization parameters in light water have been made by the pulsed neutron source and non 1/v absorber method. In an effectively infinite system of poisoned water, an asymptotic decay constant was measured by detecting capture γ-rays emitted from the whole volume of this system. The thermalization parameters were derived from values of decay constants measured over a wide range of non 1/v absorber concentration. Measured values of these parameters were compared with values calculated from Nelkin, Egelstaff-Schofield and McMurry-Russell kernels. (auth)

35698 MEANS FOR SUPPORTING FUEL ELEMENTS IN A NUCLEAR REACTOR. (to Westinghouse Electric Corp.). British Patent 1,116,106. June 6, 1968. Priority date May 25, 1965, United States.

The description of reactor fuel element support structure is presented. The structure supports fuel elements in vertical parallel arrangement. The grid support contains a lateral structure penetrated by the fuel elements. Resilient and rigid longitudinal supports are laterally displaced at each grid opening by 90°. The resilient supports are rippled-spring strips running longitudinally of the fuel elements. (D.C.C.)

35699 CURTAILMENT OF NEUTRON SLOWING DOWN INTERVAL IN MULTIGROUP CALCULATION. Mizoo, Nobutatsu (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 258-9(May 1968).

A correction for the conventional method for curtailing the neutron slowing down interval in the case of scattering with hydrogen is presented. The correction conserves the scattering slowing down source in multigroup calculations. (H.D.R.)

35700 CALCULATION OF SPACE-DEPENDENT REACTOR TRANSFER FUNCTION BY FEW-POLE EXPANSION METHOD. Hoshino, Tsutomu; Wakabayashi, Jiro (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 5: 229-35(May 1968).

The few-pole expansion method gives an approximate solution of the general space-dependent linear kinetics. The mathematical meaning of this method is first briefly described. A numerical calculation of the space-dependent, two-group, two-region reactor transfer function is made with the use of the few-pole expansion. Even an expansion with only two terms is found to provide good agreement with the transfer function measured by pile-oscillator. (auth)

35701 METHOD OF AND APPARATUS FOR DETERMINING THE INSTANTANEOUS OUTPUT OF A NUCLEAR REACTOR. Fishman, Y. (to Sulzer Brothers Ltd.). Canadian Patent 783,128. Apr. 16, 1968. Priority date Sept. 19, 1963, Switzerland.

The instantaneous output of nuclear reactor is achieved by multiplication of the signal representing the neutron flux at some location in the reactor together with a signal which is dependent upon the heat output of the reactor. Some additional comparisons and multiplications are necessary to obtain a smoother reading. (F.S.A.)

35702 GAMMA SPECTROMETRIC DETERMINATION OF NUCLEAR FUEL BURN-UP. Vaeyrynen, Heikki. Tek. Aikak., No. 4B, 33-6(1968). (In Finnish).

Fission reactions occurring in a nuclear reactor lead to considerable changes in the composition of the fuel elements during their lifetime in the reactor. By studying the fission products formed during the fuel irradiation, information about the energy taken from a fuel element and the spatial distribution of this energy can be obtained. An effective method for this study, i.e., the measurement of gamma radiation from the fission products by means of the semiconductor detectors, is described. (auth)

35703 REACTIVITY DETERMINATIONS WITH THE AID OF A PULSED NEUTRON SOURCE. Regnell, Bjarne. Tek. Aikak., No. 4B, 14-18(1968). (In Finnish).

The theoretical basis of the pulsed neutron source method is presented as well as the methods of Garelis–Russell and Gozani for analyzing measured data. The experimental facilities and procedures are described and some results obtained at the subcritical reactor at Otaniemi are given. (auth)

35704 MODAL EFFECTS IN THE TRIPLE-CORRELATION REACTOR-NOISE EXPERIMENT. Dragt, J. B. (Reactor Centrum Nederland, Petten). pp 477-92 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Recently the point reactor theory for detection of three correlated counts has been presented. Two types of family-trees for the three related neutrons have to be distinguished: in one the tree twice branches in two; in the other type there is a threefold splitting. The extension to include space dependence is presented. The triple correlation function is generalized to: $n(t)\{n(t+\sigma) - n(t+\sigma+\tau)\}\, n(t+2\sigma+\tau)$, permitting better discrimination against higher modes. An experiment was performed for measuring the triple correlation functions, by coupling a reactor on-line to a digital computer. Since a thermal reactor was used, only very rough results could be obtained, in spite of the long measuring time. The spatial effect was clearly observed, not the threefold splitting effect. (auth)

35705 PROBABILITY DISTRIBUTION OF NEUTRON COUNTS FOR THE p-METHOD IN REACTOR NOISE ANALYSIS. A NUMERICAL CALCULATION. Tuerkcan, E.; Dragt, J. B. (Reactor Centrum Nederland, Petten). pp 467-75 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The p-method in reactor noise analysis is the technique, proposed by Zolotukhin and Mogil'ner, of measuring the probabilities p_k for detecting k neutrons in a certain time interval. Reactor parameters may be derived from the probability distributions. Because of its simplicity and high speed this method seems to be very attractive for application in fast reactors. A numerical technique for a calculation of the case for which a probability generating function has been derived is presented. A point reactor model is assumed, with neglect of delayed neutrons and some very improbable branching processes. The procedure is presented for obtaining numerically the distribution from the generating function. It is a multiple recurrence calculation that has been programmed in Algol-60 for the El-X8 computer. Several examples of the calculated distributions are given. A comparison is made with the approximating distributions, and conclusions are obtained on the range of validity of the approximations. Moreover, the calculated distributions are compared to some experimental ones, and the agreement is found to be excellent. The problem of fitting theoretical to experimental distributions is discussed. (auth)

35706 ALPHA DETERMINATION FROM TRANSFER FUNCTION, OBTAINED BY PULSED NEUTRON ANALYSIS. Rotter, W. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 435-51 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

Measurements in a sub-critical lattice have shown that the spatial dependence of the transfer functions is the same, whether they are determined by modulating a neutron source or by analyzing the pulsed neutron response. When defining a transfer function for prompt neutrons, its spatial dependence can be eliminated to a high degree if only the harmonic free part of the pulse response is used for the analysis. The decay constant α can be determined from these "reduced" prompt transfer functions. The sensitivity of this method on systematic deviations from the pure exponential decay offers some valuable checks in the interpretation of pulsed neutron experiments. Also the constant background, i.e., the delayed neutron tail can be determined with high accuracy. The elimination of the spatial dependence in the transfer functions results in a correction factor for the time integral of the prompt neutron response. When it is applied to Sjöstrand's area ratio, the corrected value is in rather good agreement with the extrapolated area ratio (Gozani) and the reactivity obtained by the $k\beta/l$ method of Garelis-Russell. (auth)

35707 THEORETICAL AND EXPERIMENTAL ANALYSIS OF FAST NEUTRON SPECTRA. Van Dam, H.; Kleijn, H. R. (Reactor Instituut, Delft, Netherlands). pp 377-87 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The object of the programme is to determine experimentally a number of microscopic reactor physics parameters such as conversion potentials, fission ratios and Doppler coefficients for simple geometries and material compositions. Attention is concentrated on both the measurement and the calculation of fast neutron spectra. The transport of neutrons in absorbing and nonabsorbing heavy atom materials is studied by solving the Boltzmann equation. Both isotropic and anisotropic scattering are considered. Anisotropic scattering is treated by the P_n-approximation, while flux-anisotropy is handled with the S_N-method. In the code FAST-DELFT, scattering is treated up to the P_4 component, a further extension of which is useless because of the lack of available cross-section data. The results of this work are presented. (auth)

35708 SENSITIVITY STUDY OF FAST REACTORS USING GENERALIZED PERTURBATION TECHNIQUES. Gandini, A. (CNEN, Rome); Salvatores, M.; Dal Bono, I. pp 241-53 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

A broad sensitivity study is presented relative to integral quantities of interest for fast reactor evaluation, namely sodium effects, Doppler coefficients, prompt neutron lifetimes, using generalized perturbation techniques. Deviations roughly typical of present uncertainties are assumed for differential nuclear data, and therefore the results obtained are fairly indicative of the inaccuracies to be associated with theoretical predictions. (auth)

35709 CALCULATION OF TEMPERATURE-DEPENDENT EFFECTIVE NEUTRON CROSS-SECTIONS. Mueller, A. (Siemens AG, Erlangen, Ger.). pp 151-66 of Fast Reactor Physics. Vol. I. Vienna, International Atomic Energy Agency, 1968.

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.1); CONF-671043-(Vol.1).

The reliability of the Doppler coefficient, which is of decisive importance for the safety of fast reactors, depends strongly on the error margins for the temperature derivatives of the effective neutron cross sections used in multi-group perturbation theory. Because in the energy region relevant for the Doppler effect most resonances of the fertile and all resonances of the fissile material are still unresolved, the evaluation of cross sections must start with statistical parameters extrapolated from resolved resonances and subject to large errors. The interdependence between the most important statistical resonance parameters and the temperature derivatives of the effective cross sections are presented. After an outline of the method chosen for the evaluation of these temperature derivatives, some improvements are discussed. As the well-known J-function and its derivative with respect to both variables play an important part in the calculation, efficient sub-routines for these functions are required. Asymmetric interference scattering is included by generalizing the J-function and approximating the correction term. The contribution to the temperature derivatives resulting from overlapping between resonances of the same sequence depends on the choice of the resonance distribution law. The improved method is applied to a typical fast reactor with different sets of input data. The interdependence between statistical parameters and the resulting temperature derivatives is studied by calculations with 10% change in one parameter only. Given error margins for the statistical resonance parameters lead to the desired error estimates for the temperature derivatives of the effective cross sections. Comparison with the equivalent changes in cross sections for infinite dilution offers the possibility of checking these error margins. (auth)

35710 APPROACH TO THE ASYMPTOTIC DENSITY OF NEUTRONS SLOWING DOWN FROM A DELTA-FUNCTION SOURCE. Williamson, T. J.; Albrecht, R. W. (Univ. of Washington, Seattle). Nucl. Sci. Eng., 33: 141-3(1968).

Equational analysis of the physical behavior of a neutron pulse as it slows down and approaches its asymptotic distribution is presented. (D.C.C.)

35711 TIME-DEPENDENT NEUTRON THERMALIZATION IN FINITE LIGHT WATER SYSTEMS. Dorning, J. (Brookhaven National Lab., Upton, N. Y. Columbia Univ., New York). Nucl. Sci. Eng., 33: 81-92(1968). (BNL-12009).

The pulsed-neutron experiment fundamental mode discrete time-decay constant has been calculated as a function of system size for spherical light water assemblies using realistic H_2O scattering models by the discrete-ordinates method. Comparison with experiment shows agreement to be good. The computed energy spectra and angular distributions of the fundamental mode neutron fluxes are discussed and physical interpretations of their behavior are proffered. The effect of including various orders of anisotropy in the scattering kernel is examined. Decay-constant calculations were also performed for a model that neglects chemical binding. The results are compared with those based on models that include binding (and are in good agreement with experiment). The effects of chemical binding in neutron thermalization are shown to be significant by this comparison. (auth)

35712 COMMENTS ON A PAPER ON NUCLEAR REACTOR THERMAL DESIGN. Judge, F. D.; Bohl, L. S. (General Electric Co., Schenectady, N. Y.). Nucl. Sci. Eng., 33: 146(1968).

Comments concerning the application of proper credits to statements made by Judge and Bohl are presented. The credit for statements concerning power flattening lowering total output power are denied. (D.C.C.)

35713 REPLY TO COMMENTS ON A PAPER ON NUCLEAR REACTOR THERMAL DESIGN BY JUDGE AND BOHL. Gueron, Henri M. Nucl. Sci. Eng., 33: 146(1968).

Comments concerning the application of proper references to statements presented by Judge and Bohl are included. The explanation of the use of "single-channel case" and "N-channel case" is presented. (D.C.C.)

35714 TRANSPORT THEORY OF NEUTRON WAVE PROPAGATION IN POLYCRYSTALLINE MEDIA. Duderstadt, James J. (California Inst. of Tech., Pasadena). Nucl. Sci. Eng., 33: 119-27(1968).

The propagation of neutron waves in polycrystalline moderators is analyzed via a modeled velocity-dependent transport theory. Analytical results are made possible by the use of a simple model of the scattering kernel. Particular attention is devoted to the interpretation of neutron wave experiments performed in graphite parallelepipeds. It is found that, while a plane wave mode is not always dominant asymptotically in polycrystalline materials, a meaningful experiment can be performed provided certain restrictions on detector position and source frequency are observed. (auth)

35715 A THREE-DIMENSIONAL P_N SPHERICAL HARMONICS THEORY IN CYLINDRICAL GEOMETRY. Maeder, C. (Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Sci. Eng., 33: 128-38(1968).

A cylindrical system of finite height is considered, consisting of a series of homogeneous, concentric annular zones surrounded by moderator in the radial direction. For this system, a complete solution of the monoenergetic, stationary neutron transport equation is found in the P_N spherical harmonics approximation. In the moderator, the scalar flux converges asymptotically towards the solution of the diffusion equation. When coupled with the heterogeneous (source-sink) theory, the method yields the scalar flux in a reactor and, after minor modifications, also applies to the exponential assembly. (auth)

35716 EVALUATION OF THE DEPARTURE FROM NUCLEATE BOILING IN BUNDLES OF REACTOR FUEL RODS. Tong, L. S. (Westinghouse Electric Corp., Pittsburgh). Nucl. Sci. Eng., 33: 7-15(1968).

Flow boiling crisis is categorized into at least two types: Departure from Nucleate Boiling (DNB) in the subcooled and low-quality region and dry-out in the high-quality region. To analyze the DNB flux in a rod bundle, the flow conditions are evaluated by a subchannel analysis and a single-channel DNB correlation is used for predictions. Rod-bundle DNB data are presented to verify the above statement. The uncertainties in the measured DNB heat fluxes are listed as: statistical nature of flow turbulences and surface conditions, ±3%; fabrication tolerances of test sections, ±5%; imperfectness of correlation in handling the parameter effects, ±5%; and random and systematic instrumentation errors and various loop system characteristics, ±10%. The probability of a rod bundle reaching DNB for a given DNB ratio predicted by W-3 correlation is evaluated and demonstrated for its use. The effect of a DNB rod in a rod bundle is considered as not detrimental and not contagious. The above statement is demonstrated and evidenced by a photograph of the bird's-eye view of DNB and two sets of experimental data. (auth)

35717 NEUTRON SCATTERING BY REACTOR-GRADE GRAPHITE. Whittemore, W. L. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng., 33: 31-40(1968).

The details of neutron scattering in reactor-grade graphite are presented. The scattering into various angular directions between 30 and 120° has been studied for incident neutrons with energies ranging up to 0.611 eV. The energy-transfer cross sections, corrected for plural scattering effects, have been evaluated to provide data in regions of large energy and momentum transfers not previously available and not readily accessible to experimenters using a reactor as a source of neutrons. The results are quite definitive and, when compared to the best available theory, indicate some regions of good agreement and some regions where a more complete theoretical treatment would be useful. (auth)

35718 CODE SPEX-1: A HITAC 5020 FORTRAN-IV CODE FOR ONE-DIMENSIONAL CALCULATION OF THE SPACE-DEPENDENT REACTOR POWER EXCURSION. **Wakabayashi, Jiro; Yoshikawa, Hidekazu; Hoshino, Tsutomu. Tech. Rep. Eng. Res. Inst., Kyoto Univ., No. 139, 1-27(Mar. 1968).**

The SPEX-1 written in HARP-5020 for the HITAC 5020E computer is described. The code computes the space-dependent power excursion of multi-region reactors considering Doppler and/or void effect as internal feedback by using the modified Helmholtz modal expansion method. The reactor geometry is restricted within one-dimensional slab, sphere, or cylinder. (auth)

35719 INTEGRAL METHOD OF ABSOLUTE MEASUREMENTS OF A NUMBER OF NUCLEAR REACTOR CHARACTERISTICS. **Mogil'ner, A. I. At. Energ. (USSR), 24: 78-82(Jan. 1968). (In Russian).**

It has been shown that a definite integral relation for the statistical weights of reactor material components is characteristic for critical reactors. This theorem is generalized to an arbitrary reactor. The critical equation of a reactor is written as a balance of worth in a diffusion approximation along with the equation for the effective coefficient of neutron multiplication. A term K^+ is introduced. This term has many of the features of K_∞ and can be considered as its generalization to a finite reactor. The term K^+ is physically the average number of generated neutrons per single absorption. Worth is used as a weight multiplier during averaging. The term K^+ can be measured directly in finite reactors. The term K^+ is primarily determined by the composition of the active zone, and depends only slightly on the size of the reactor and reflector material. It is shown that the total statistical weight of the reactor materials is equal to twice the probability of loss of worth due to neutron leakage. The important term K^+ can be determined by measuring the total statistical weight. If the value of K^+ is known, the absolute value of the criticality of a reactor or of the efficiency of the regulating rods can be obtained by relative measurements without a reactor excursion.

35720 MONTE CARLO CODE FOR CALCULATING THE DOPPLER EFFECT IN FAST REACTORS. **Rothenstein, W.; Naot, D. (Technion–Israel Inst. of Tech., Haifa). pp 329-42 of Fast Reactor Physics. Vol. II. Vienna, International Atomic Energy Agency, 1968.**

From Symposium on Fast Reactor Physics and Related Safety Problems, Karlsruhe, Germany. See STI/PUB-165(Vol.2); CONF-671043-(Vol.2).

A Monte Carlo code for calculating the Doppler effect between specified energy limits in fast reactors is described. Neutron histories are followed through the energy interval in which temperature changes in the reactor affect the multiplication rate. The normalization of the results requires additional information which may be obtained from suitable multigroup calculations. The reaction rates and their changes with temperature are obtained from Monte Carlo estimates of the unperturbed flux, and adjoint weighted with group adjoint fluxes specified in the input. Allowance is made for the resonance fine structure of the importance functions within the narrow resonance approximation. Geometry routines have been prepared for multiregion spherical geometry, each region containing a homogeneous mixture, and for a multilayer cylindrical geometry with a number of regions in each layer. There is also an option for infinite lattice calculations with top and bottom blankets and reflectors. The resonance cross-sections are based on the Doppler broadened Breit–Wigner single level formula and contain $l = 0$ and $l = 1$ contributions, the resonance parameters being chosen from their average values and distribution functions. The code is of value in studying the influence of different temperature excursions on the Doppler effect, since different temperature changes can be specified in each region of the assembly. Interference effects between different resonance sequences are automatically included. The $l = 1$ wave contribution to the Doppler effect can be investigated and core heterogeneity effects studied. Results are presented showing the type of accuracy of the estimates obtained. In a typical run for a 2500-litre oxide-fuelled spherical assembly the contribution to the Doppler effect in the 16th group of the YOM set was obtained with confidence limits of ±8% on the 50% level in about 5 min computation time on the Philco 2000 computer, when only the $l = 0$ contributions of the nearest resonances of uranium and plutonium to the neutron energy were included in the cross-section calculations. (auth)

35721 RESONANCE ABSORPTION IN A DOUBLE HETEROGENEOUS ASSEMBLY OF SPHERICAL FUEL ELEMENTS. **Teuchert, Eberhard (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 11: 68-72(May 1968). (In German).**

A pebble-bed reactor consists of a random distribution of spherical fuel elements, each containing a random distribution of coated particles. For such a double heterogeneous assembly, the geometric escape probability $P(\sigma_a)$ is calculated by a numerical method. It is made available to the ZUT-code from Nordheim, Kuncir for resonance integral calculation. For coated particles of large size the total resonance integral becomes smaller by about 16% compared to a single heterogeneous calculation in which the coated particle regions are thought to be homogenized. The transition to the single heterogeneous assembly, by decreasing the coated particle size, is discussed. A Dancoff-Ginsburg factor C for the double heterogeneous case is derived for the use in traditional resonance integral calculations. (auth)

35722 ON THE VARIATIONAL AND BUBNOV–GALERKIN SYNTHESIS OF THE EPITHERMAL, SPATIALLY DEPENDENT NEUTRON ENERGY SPECTRA. **Toivanen, T. (Technical Univ. of Helsinki, Otaniemi, Finland). J. Nucl. Energy, 22: 283-97 (May 1968).**

The method of overlapping neutron energy spectra is considered from the point of view of functional analysis. In order to achieve the highest possible accuracy with only a few separable trial spectra, more freedom is allowed to the variational principle by leaving both the energy and space dependence of the trial spectra undetermined. A Galerkin synthesis program coded for the Elliot 503 computer involves a self-consistent iteration between the energy and space computations, and utilizes infinite media spectra as the zero-th stage of iteration. As a numerical test problem, the spatially dependent epithermal multigroup spectrum in an intermediate, spherical, graphite diluted and reflected core containing 100 per cent enriched U fuel is synthesized from two separable spectra, and the results are compared with those calculated by a standard 21-group P_1 program. (auth)

35723 GREEN'S FUNCTIONS IN SPACE-ANGLE NEUTRON TRANSPORT THEORY. **Boffi, V. C. (CNEN, Bologna). Nukleonik, 11: 95-106(May 1968).**

The study of the space-angle transport distributions of monoenergetic neutrons diffusing in a medium of infinite extent is carried out through an extensive application of the two-sided Laplace integral theory. Both the cases of isotropic and anisotropic scattering are treated and the corresponding solutions are exactly derived. (auth)

35724 NEUTRON NOISE IN A REACTOR WITH AN EXTERNAL CONTROL LOOP. **Borgwaldt, Horst (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 11: 76-84(May 1968).**

The noise in the neutron detector signal from a reactor with an external control loop is theoretically investigated. Delayed neutrons are included. A practical formula for the noise power spectral density contains 4 contributions: (1) White detector noise, (2) noise from an external reactivity perturbation, (3) noise of the same origin (i.e., branching processes) as that observed in zero-power experiments, (4) noise produced in the control loop by the neutron detection process. A rigorous stochastic treatment shows, that this formula is a very good approximation, when the neutron population is high and its fluctuations are sufficiently small. (auth)

35725 ON THE APPROXIMATE DETERMINATION OF THE CRITICAL BUCKLING IN TWO-DIMENSIONAL HOMOGENEOUS REACTORS. **Osredkar, M.; Trampuz, C. (Univ. of Ljubljana, Yugoslavia. Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Nukleonik, 11: 110-12(May 1968). (NIJS-R-52).**

The method of effective boundary conditions for one group calculation is applied to unreflected reactor cores to simplify the calculation of the critical buckling for geometries which cannot, or only with difficulties, be treated analytically. An approximate operator N_{app} of the reciprocal extrapolation length is determined and the exact buckling K is compared with the approximate one, K_{app}, in order to determine the range of applicability of the proposed method. (auth)

GENERAL

35726 (BNWL-672) PLUTONIUM ABSTRACTS. Volume 7, Number 12. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 31, 1967. Contract AT(45-1)-1830. 52p. Dep. CFSTI.

Ninety-eight abstracts of papers on developments in plutonium technology are presented under the following headings: biology and medicine, chemistry, health and safety, metallurgy and ceramics, miscellaneous, physics, propulsion systems and energy conversion, and reactor technology. (M.C.G.)

35727 (BNWL-725) STATE OF THE ART SURVEY OF THE DATA DISPLAY FIELD. Mahan, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 69p. Dep. CFSTI.

A survey was undertaken in order to provide a comprehensive study of the data display field to establish support for the preparation of a Systems Design Description for Systems 91 Unified Control. The scope of the survey is limited to computer-generated displays capable of operating in real-time on a dynamic control system. The scope is further limited to visual displays that present information to the eye by means of visual cueing. Emphasis is placed on the current state-of-the-art and future expectations of the data display field. A tabulation of commercially available console displays and a comprehensive display bibliography are provided in an Appendix. A bibliography containing 152 references is also included. (auth)

35728 (CERN-68-19) INTEGRATED CIRCUIT LOGIC MODULES SERIES. Cajano, N.; de Meo, P. (European Organization for Nuclear Research, Geneva (Switzerland)). May 16, 1968. 120p. Dep.

Integrated circuit technology, reliability, logic families, and modular packaging are discussed, and the development of an integrated circuit logic modules series is described. The NPA series now includes 19 modules. The logic functions range from basic NAND gates to D and J-K flip-flops. Functional modules include a four-bit binary comparator, parity generator, six-bit shift register, and an up/down BCD counter. Special circuits include an integrating multivibrator, monostable multivibrator, transmitter, receiver, input logic level converter, and an output logic level converter. The characteristics of the NPA integrated circuit modules series are described, and the technical specifications of the modules are given. (W.H.K.)

35729 (JPRS-45331) SOVIET ATOMIC SCIENCE AND ENGINEERING. Shchelkin, K. I. Translation of Sovetskaya Atomnaya Nauka i Tekhnika, Atomizdat, Moscow, 1967. 509p. GPO.

Various topics on Soviet science and engineering are discussed. These are first Soviet atomic reactors, research reactors, physical investigations of nuclear reactors, atomic electric power stations, atomic icebreaker Lenin, charged particle accelerators, high energy physics, 70-GeV proton synchrotron, heavy ion accelerator, methods of synthesis and properties of transuranium elements, controlled thermonuclear reactions in the USSR, technology of uranium ore processing, atomic materials science, radiochemistry nuclear instrument building, atomic energy in biology and medicine, usage of nuclear radiation in agriculture, radiation engineering radiation safety, and international cooperation. (B.G.D.)

35730 (K-1739) FLOW AND SELF-DIFFUSION OF GASES IN CAPILLARIES. PART III. Lund, L. M.; Berman, A. S. (Oak Ridge Gaseous Diffusion Plant, Tenn.). June 20, 1968. Contract W-7405-eng-26. 155p. Dep. CFSTI.

The detailed data involved in the model and data interpretation presented in Parts I and II (for abstracts see NSA 20: 30174 and 20: 30175, respectively) are presented in 94 tables. Details of the equipment and experimental technique including the theory and practice of the primary measurements are included. (auth)

35731 (LA-3830) PREDICTABLE UNFOLDING IN THE TIME DOMAIN. Hodson, E. K. (Los Alamos Scientific Lab., N. Mex.). Sept. 1967. Contract W-7405-eng-36. 48p. Dep. CFSTI.

The convolution integral generally lends itself readily to numerical solution. The inverse numerical process, unfolding, frequently produces divergent solutions, and nearly always seriously increases the noise present in the resulting tabular function. Since noise is present in all experimentally derived tables (even sampling of virtually noise-free data may produce noise), this is considered to be a major cause of divergent or oscillatory solutions. The influence of noise on the unfolding process is controlled predictably by the method described here, in which a modified (constrained) inverse of the system response function is folded with the data. To generate the constrained inverse we unfold a properly chosen filter with the system response function, g(t), modifying the latter by truncation of its early portion. When this modified inverse is convolved with the data to be unfolded, noise enhancement is minimal. CONFOLD is a computer program which determines the minimum required truncation of g(t) by iteration, and unfolds a Gaussian filter, producing a constrained inverse which is then folded with the data. The unfolded frequency response is computed by use of the Fourier integral. CONFOLD will also evaluate the frequency response of g(t), making it possible to predict filter characteristics giving the best compromise between bandwidth and noise suppression. The program may be used either for folding or unfolding. Its normal outputs are Stromberg 4020 paper listing and punched cards. (auth)

35732 (LA-3940) MECHANISM OF CATALYTIC POLYMERIZATION AND COPOLYMERIZATION OF LOWER ALKYL VINYL ETHERS (R = METHYL THROUGH BUTYL): A BIBLIOGRAPHY. Furnish, Jean (comp.) (Los Alamos Scientific Lab., N. Mex.). Mar. 20, 1968. Contract W-7405-eng-36. 21p. Dep. CFSTI.

A search of Chemical Abstracts, Vol. 44 (1950) to Vol 68, No. 10 (March 4, 1968), was made for information on mechanisms of catalytic polymerization of lower alkyl vinyl ethers. Entries in the bibliography, containing 207 references, are arranged in order of date of publication with the most recent given first, then alphabetically by author. An author index is included. (M.C.G.)

35733 (NYO-3242-26) INACTIVATION OF SOME ENZYMES IN AQUEOUS SOLUTION BY ATOMIC HYDROGEN. Stein, Gabriel (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). Apr. 1968. Contract AT(30-1)-3242. 21p. (CONF-670422-1). Dep. CFSTI.

From Conference on Energetics and Mechanisms in Radiation Biology, Portmeirion, Wales.

Methods for quantitative study of the mechanisms and rate constants of the reactions of H atoms as the only reactive species in aqueous solutions were developed. The results on solutions of enzymes such as cytochrome-c, chymotrypsin, trypsin, and ribonuclease are discussed. It is shown that in these complex molecules highly specific reactions occur, affecting the metal ion, when present, and aromatic as well as divalent-sulfur-containing amino acids. (auth)

35734 (ORNL-4244) DIFFRACTION PATTERN AND STRUCTURE OF AQUEOUS AMMONIUM FLUORIDE SOLUTIONS. Danford, M. D. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 42p. Dep. CFSTI.

The scattering of x rays from the free surface of 1.18 and 10.87$\underline{M}$ solutions of NH_4F in water was measured and analyzed at 25°C. Both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. The data were interpreted in terms of the proposed model for pure liquid water. Experimental intensity and radial distribution functions are compared to those for water, along with theoretical intensity functions calculated from the model parameters. (auth)

35735 (ORNL-TM-2103) THE PHILADELPHIA CHROMOSOME IN LEUKEMIA RESEARCH: A BIBLIOGRAPHY. Stemple, Ruth M. (comp.) (Oak Ridge National Lab., Tenn.). Mar. 1968. Contract W-7405-eng-26. 19p. Dep. CFSTI.

A list of 354 references to the literature on the interrelationships between the leukemias and the Philadelphia chromosome is presented. (H.L.W.)

35736 (ORNL-TM-2166) EXTRAPOLATION ALGORITHM FOR SPECIAL ORDINARY INITIAL VALUE PROBLEMS BASED ON AN ELEMENTARY TRIGONOMETRIC MULTISTEP FORMULA. Hammons, C. E. (Oak Ridge National Lab., Tenn.). June 1968. Contract W-7405-eng-26. 64p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

It was desired to know if a trigonometric analog to a classical method for the solution of special second order initial value problems would provide a better approximation to the exact solution for those problems whose solutions are periodic in nature and to see if the analog could be defined in such a manner that "extrapolation to the limit" could be justified. The analog was defined to be exact for certain trigonometric monomials and under suitable hypotheses on the initial value problem, was shown to be convergent. It was also shown to have an asymptotic expansion in even powers of the step, h, under these hypotheses. These results provide a justification for "extrapolation to the limit" by means of the Neville algorithm. Some numerical results were obtained to verify these results experimentally. (auth)

35737 (RFP–1081) ANNOTATED BIBLIOGRAPHY OF CURIUM. Miller, H. W. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 1, 1968. Contract AT(29-1)-1106. 87p. Dep. CFSTI.

Five hundred and ten references on curium, complete to the year 1967, are presented. The bibliography is divided into two main sections: chemistry and physics. These two sections are further subdivided into categories. Author, subject, and organization symbol indexes are included. (M.C.G.)

35738 (SC-CR-67-2670) TELTAC: A TELETYPE TAPE-TO-CARD CONVERSION PROGRAM. Vandevender, Sharla G. (Dikewood Corp., Albuquerque, N. Mex.). May 1968. Contract 2859-008. 42p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

An OSAS-A program for the CDC 160-A computer to convert Teletype paper tape data to punched card data is described. The program called TELTAC (TELetype TApe to Cards), which is written for a CDC 160-A computer, accepts Teletype-produced eight-level ASCII paper tape input to produce a card deck on a one-line-per-card basis. TELTAC may process several tapes at one run if the operator restarts the program for each tape. The program may be expanded by the addition of subroutines to be called upon recognition of any of the operation codes which presently cause a branch to the dummy subroutine, NOPR. (auth)

35739 (TID–3746) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period March-April 1968. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 10p. Dep. DTIE Free.

Seventy bibliographies issued or in preparation during March and April 1968 on atomic energy literature are listed. A report number index is also included. (B.G.D.)

35740 (TID–4043(Rev.3)(Suppl.)) INDEX TO CONFERENCES RELATING TO NUCLEAR SCIENCE. Clark, Willie E.; McGinnis, Doris H.; Patterson, Carol B. (eds.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). July 1968. 214p. CFSTI.

This supplement updates TID-4043 (Rev. 3) Index of Conferences Relating to Nuclear Science, July 1966, by indexing conferences included in Nuclear Science Abstracts, Volumes 20 (1966) and 21 (1967). The supplement consists of four parts: Permuted Titles and Cities, Numbered Conferences, Report Numbers, and Title List. (B.G.D.)

35741 (UCRL–18200) CONDUCTIVITY AND ELECTRODE POLARIZATION IN MOLTEN SODIUM DISILICATE GLASS CONTAINING IRON. Schweinberg, Richard Norman (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1968. Contract W-7405-eng-48. 44p. Dep. CFSTI.

Thesis.

Sodium disilicate glasses with 0 to 20% FeO additions were studied at 1000 to 1100°C under constant dc and ac potentials, which included 0.2 and 0.4 volts. The drop in current with time under a dc potential was recorded with iron electrodes and the concentration distributions that resulted from ionic movement were analyzed using the electron microprobe. Iron entered from the anode by replacement of fast-moving sodium ions, which migrated towards the cathode. Near the cathode, a cloud of metallic sodium was formed and iron dendrites grew from the electrode into the glass. A side reaction Na_2O (glass) + Fe $\rightarrow$ FeO (glass) + Na occurred at the iron electrodes, which was apparent at the cathode since the conductivity mechanism would not require the appearance of iron. The nature of the cathode material did not affect the current vs time curves. In order to separate the ionic and electronic contribution to the conductivity, total current and final electronic current figures were needed. Alternating current frequency ranges of 0.5 to 50 kc and initial dc peak currents were investigated to give total current readings. Blocking electrodes (attached only slightly by a glass-electrode reaction) such as gold and platinum were used at the anode in order to obtain essentially the electronic current. Increasing FeO contents increased both the ionic and electronic contributions to the conductivity. Different dc peaks and ac frequency curves were recorded for iron, gold, and platinum electrodes at each FeO concentration. Since electroneutrality must be maintained, the steady-state composition in the glass at the anode and the mobility of the anode cation appears to be the controlling factors in molten glasses in determining the nature of polarization and the ionic conduction. (auth)

35742 (UCRL–50417) PLATINUM WORKING ELECTRODE CELL FOR CONTROLLED-POTENTIAL COULOMETRY. Harrar, J. E. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1968. Contract W-7405-eng-48. 7p. Dep. CFSTI.

Construction and operational details are given for a platinum working electrode cell assembly suitable for controlled-potential coulometry and electrolysis. The cell, designed for electrolyses of milligram quantities of material, features a glass cell with a threaded Teflon cap. (auth)

35743 (Y–1619) VELOCITY READOUT SYSTEM FOR AN IMPACT TEST MACHINE. Henry, J. J. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 4, 1968. Contract W-7405-eng-26. 10p. Dep. CFSTI.

A noncontact velocity readout system for an impact test machine has been designed. This system measures velocity with an optical-electronic-generated, time-interval measurement from a distance template. An accuracy of ±0.05 ft lb has been obtained. Calibration data for the system have been determined. (auth)

35744 NUCLEAR LAW BULLETIN. NUMBER 1. Nucl. Law Bull., No. 1, 1-47(Feb. 1968).

Various aspects of nuclear law are presented. These are legislative and regulatory activities, case law and administrative decisions, international organizations and agreements, and important texts of legislative work and case decisions. (B.G.D.)

35745 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1969. PART 2. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION, ON NUCLEAR ROCKET (ROVER); SPACE ELECTRIC POWER; PHYSICAL RESEARCH; RAW MATERIALS; ISOTOPES DEVELOPMENT; BIOLOGY AND MEDICINE; PLOWSHARE; SPECIAL NUCLEAR MATERIALS; COMMUNITY; PROGRAM DIRECTION AND ADMINISTRATION; TRAINING, EDUCATION, AND INFORMATION; AND WEAPONS, FEBRUARY 7 AND 21, 1968. Washington, D. C., Joint Committee on Atomic Energy, 1968. 1188p. GPO $3.50.

35746 ATOMIC ENGINEERING. Ind. At., Mem. Annu., 12: 21-70(1968). (In French).

Tabulations are compiled on the most significant aspects of nuclear engineering at the end of 1967—minerals, metals, and fuels; power reactors in the world; properties of nuclear materials; radioisotopes; sealed sources available at the CEA; radiations; and accelerators in excess of 1 BeV. Under minerals, metals, and fuels tabulations are given of production of U ores in the European Common Community in 1963, fabrication of fuel elements, installations for the preparation and refining of fuel elements, evolution of U reserves in France, mining development in France in 1963, production of U and Th in 1966, and production of concentration installations in France. The power reactors of the world in operation, under construction, or under design are tabulated. The tabulations on properties of nuclear materials include compatibility and incompatibility of construction materials, properties of reactor construction materials, properties of shielding materials, properties of coolants, and paths of ^{235}U fission fragments in various materials. Under radioelements the principal uses of radioisotopes, fission products usable and available in significant quantities, data on measurement methods of radioisotopes in clinical and biological use and lists of radioelements available at the CEA. The sealed sources available from the CEA are tabulated. The definitions of radiation are outlined and tabulations are presented on maximum permissible concentrations, biological effects of radiation, and reagents for the decontamination of different materials. (J.S.R.)

35747 THESAURUS IN NUCLEAR SCIENCE AND TECHNOLOGY: PRINCIPLES OF DESIGN. Uhlmann, Wolfram (Forsvarets Forskningsanstalt, Stockholm). Tek. Vetensk. Forsk., 38: 46-52(1967).

A thesaurus in nuclear science and technology is described. It contains two sets of a priori mutually independent indexing tools. One set comprises carefully defined categoric descriptors, or categories, provided with extensive cross references, the other set consists of, in general, self-explanatory specific short indexing terms and no cross references, but only occasional "use" references are included. These sets are put into logical relation by combining during the indexing process: categoric descriptors from the first set with terms from the second. Thus, on the one hand, a specification of the categoric descriptor valid for a particular document, on the other, a definition of the employed specific term(s) by means of the conjugate descriptor is attained. Furthermore, some of the logical structure of the abstract being indexed may be preserved in this manner. Examples for the use of the thesaurus and named indexing method are presented. (auth) (Sweden)